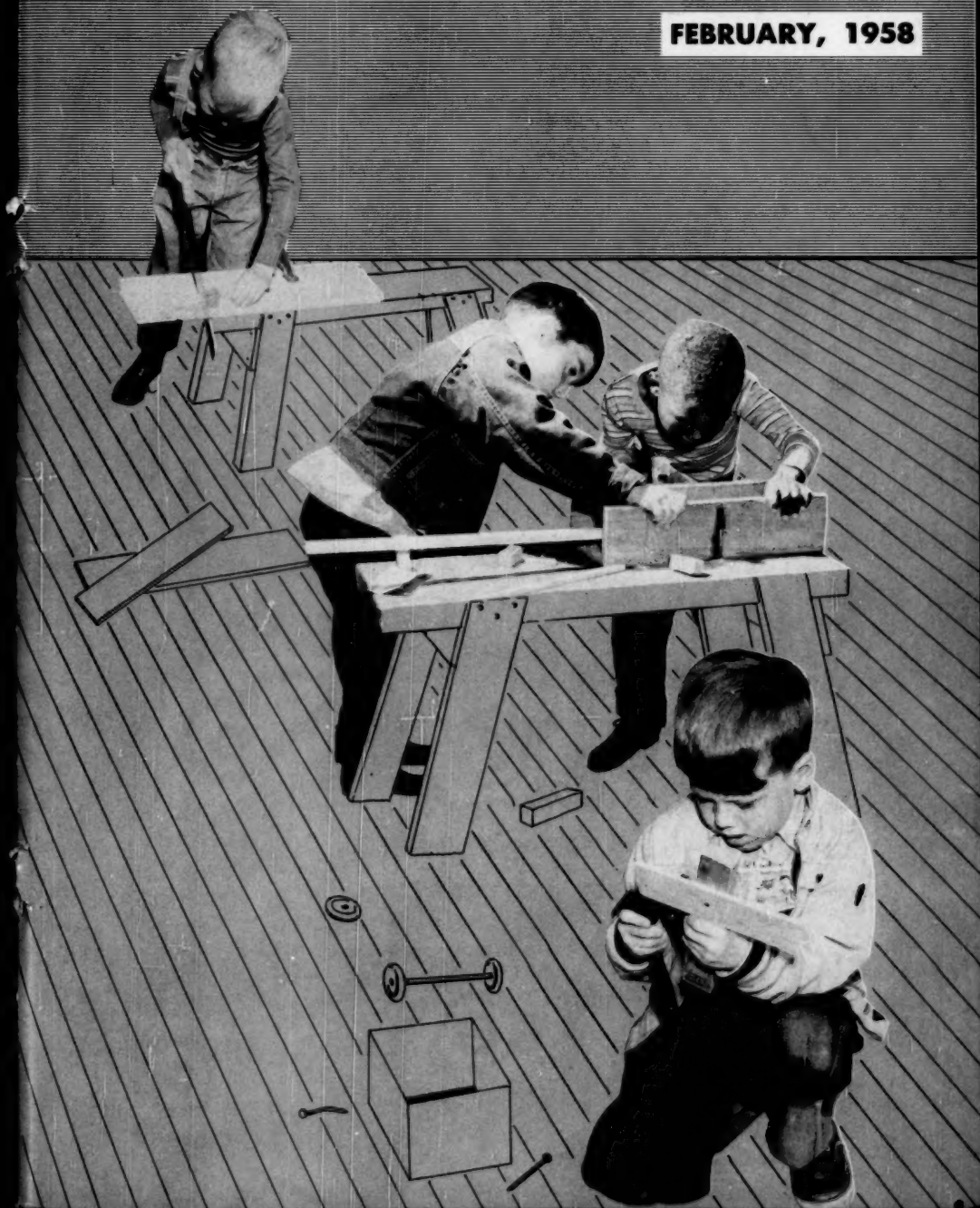
CALIFORNIA JOURNAL OF ELEMENTARY EDUCATION

FEBRUARY, 1958



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VOLUME XXVI FEBRUARY, 1958 NUMBER 3

The California Journal of Elementary Education is published quarterly in August, November, February, and May by the California State Department of Education. It is distributed without charge to school officials in California primarily concerned with the administration and supervision of elementary education and to institutions engaged in the training of teachers for the elementary school. To others the subscription price is $1.00 a year; the price for single copies is 30 cents. Subscriptions should be sent to the Bureau of Textbooks and Publications.

Entered as second-class matter September 13, 1932, at the Post Office at Sacramento, California, under the Act of August 24, 1912.

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EDITORIAL COMMENT AND NEWS NOTES

The Industrial Arts Issue of the Journal

The importance of industrial arts activities in the program of elementary education has long been recognized. Years ago when the work of the world was largely done in the home, on the farm, or in the village, children could readily understand how the basic needs of life were met. Nearly everyone knew how the various articles of food were produced and processed; nearly everyone knew how sheep were raised, their wool sheared, washed, carded, spun and woven and made into clothing. Nearly everyone knew how trees were felled, sawed into lumber, and used to build houses. The more sensitive observers may have appreciated the investment of time and energy that was required to have a freshly baked loaf of bread on the dinner table or to make a sturdy coat to shelter the wearer from winter storms. They may have given thought, now and then, to the investment of human patience, ingenuity, and inventiveness which the loaf of bread, winter coat, or durable structure involved.

But now the application of science to invention has removed many of these activities from the direct observation of children. Food comes from the supermarket, clothing from the department store. Transportation means a convenient trip by automobile, train, or airplane. How all these things came to be are far removed from children. Children can now learn firsthand little about how their basic needs are satisfied, the processes involved, the problems of the people who produce, process, and distribute the innumerable things necessary for comfortable modern living. Yet children need to understand the complex life of which they are a part and how it came to be if they are to develop the knowledge, attitudes, and appreciations essential to the steady progress of civilization.

In this "do-it-yourself" age, the school has added responsibility to help children develop skill in the use of their hands as well as intellectual activity. The relation between motor development and personality development is only beginning to challenge the interest of research workers in education, but there can be little doubt that competence in the use of the hands contributes significantly to an individual's feeling of self-worth.

Natalie White, formerly Supervisor of Fine and Industrial Arts, University Elementary School, University of California, Los Angeles, described the relation of industrial arts to the work of curriculum development in these terms:

> Educators should ask constantly what facts and principles of history, geography, arithmetic, and science do young people need assembled in close relationship in order that they may understand and reflect upon American institutions and problems? What kinds of examples, episodes, graphic and pictorial representations, problems, statistics, facts do they need to comprehend the interdependence of the modern world; the wise distribution and use of all its resources such as coal, iron, oil, and land; the improvement of education; the culture of American people? What kinds of experiences must they have to make clear and identify themselves with these problems which make living together possible. Those responsible for the education of children should ask themselves these questions in order that in the effort to answer them they will become wise, far-seeing guides who are at the same time ready to help the children to take each succeeding step which will lead toward this understanding of life to make possible rich living here and now, and the continuance and growth to a finer way of sharing life together. Part of this understanding comes through constructing those things and carrying out those processes which will make it more possible to understand and to share in the basic life experiences of people with whom the youth of today comes in close contact.[1]

In an effort to be of assistance to curriculum workers in achieving the goal that Miss White has described, two bureaus of the California State Department of Education have worked co-operatively to bring outstanding professional resources of the state together to develop this issue of the *Journal*. Helen Heffernan, Chief, Bureau of Elementary Education, and Robert L. Woodward, Consultant in Industrial Arts Education, served as consultants to the group of school people they invited to develop the material presented.

The personnel of the Committee included the following:

Walter E. Allman, Consultant, Guidance and Industrial Arts Education, Office of Riverside County Superintendent of Schools.

Mrs. Hilma Borden, Assistant Supervisor of Elementary Education, Long Beach City Unified School District

C. Thomas Dean, Chairman, Industrial Arts Department, Long Beach State College

Clifford G. Dobson, Head, Industrial Arts Department, Los Angeles State College of Applied Arts and Sciences

John Giovannoni, Jr., Supervisor of Industrial Arts, Division of Elementary Education, Los Angeles City School Districts

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[1] *Newer Instructional Practices of Promise*, Chapter VI, Newer Practices Involving Industrial Arts. Twelfth Yearbook, National Education Association. The Department of Supervisors and Directors of Instruction (now the Association for Supervision and Curriculum Development). Washington: National Education Association, 1939, pp. 93-94.

J. Lyman Goldsmith, Supervisor, Agricultural, Vocational, Industrial Arts Education, Division of Instructional Services, Los Angeles City School Districts

Mrs. Martha S. Hittinger, Principal, Rancho Santa Gertrudes Elementary School, Los Nietos

Milo Perry Johnson, Administrative Assistant and Supervisor of Vocational and Industrial Arts, Santa Monica City Unified School District

Vera Kimball, Assistant Professor, Department of Education, University of Redlands

Mrs. Alice Krehbiel, Consultant in Curriculum and Co-ordinator of Reading and Health Education, Office of San Bernardino County Superintendent of Schools

Mrs. Rosana Malumphy, Consultant in Elementary Education, Art, Office of Los Angeles County Superintendent of Schools

Gail Phares, Supervisor of Industrial Education, Burbank Unified School District

Mrs. Carol R. Poppett, Co-ordinator of Fine and Industrial Arts Education, Office of the San Bernardino County Superintendent of Schools

Philip Resnack, Supervisor of Art, Santa Monica City Unified School District

Robert Reynolds, Director of Curriculum, Oceanside-Libby Union Elementary School District

Eva A. Riecks, Supervisor of Elementary Division, Burbank Unified School District

David O. Taxis, Consultant in Industrial Arts Education, Office of Los Angeles County Superintendent of Schools

Glenn D. Warrick, Supervisor of Industrial Arts and Vocational Education, Long Beach Unified School District

So many contributions to all parts of the issue were made by all members of the committee that it was unanimously decided that no individual authorship would be indicated.

Photographs used on the cover were contributed by Long Beach City Unified School District and Los Angeles City School Districts and the Office of the San Bernardino County Superintendent of Schools. Alfred E. Bloch, Director of Art, Redwood City Elementary School District, created the cover design.

Mary-Margaret Scobey, Assistant Professor of Education, San Francisco State College, read part of the manuscript and made valuable suggestions concerning the material. She also contributed to the bibliography included in the issue.

The consultants were deeply appreciative of the enthusiasm of all members of the co-operating group and hope this spirit is predictive of increased opportunity for elementary school children in California to have more and vital experiences in industrial arts.

INDUSTRIAL ARTS FOR THE ELEMENTARY SCHOOL

Civilization, as it exists today, is the outcome of man's efforts through the ages to satisfy the essentials of life within his cultural and physical environment. Man's changes and modifications of raw materials, brought about first by hand, later by machine, and now through scientific discovery and its application, have been responsible for the formation of the complex industrial culture of today's world.

During the time of early man, understanding his world was easier for a child than it is today. His needs were satisfied as a part of his daily experience through his individual efforts to aid his family. The child performed many of the actual processes himself and was a witness to those which he did not perform. Because he did these things, or knew how they were done, he was able more fully to comprehend and to appreciate the problems of the people who did this work.

As civilization developed, industry moved from the home to urban centers. The child today rarely has firsthand experience with industrial processes or even the opportunity to observe the processes in use in his home or community. It has become the function of the school curriculum to organize school life around worth-while areas of human experience within which children may live as a social group and be involved in selected basic life experiences of people with whom they come into contact.

The total number of major industries, together with those contributing to them, number well into the thousands, each responsible for its own special skills, materials, and problems. Because of the complexity of modern industry, it is necessary that selection be made of those basic processes which will contribute most toward helping children to acquire meanings, concepts, attitudes, appreciations, habits, skills, and techniques important in building understanding of the world in which they live.

Varying Emphasis Placed on Types of Experiences

Educators place a varying emphasis on the types of industrial arts experiences that may be provided in the elementary school. One group

of educators places emphasis on the industrial arts as that phase of general education which deals with industry—its organization, materials, processes, occupations and products—and with the problems resulting from our industrial-technological society.

It is the belief of those in this group that industrial arts experiences at the elementary school level begin to orient children to the industrial society of the past and present. The elementary industrial arts program, therefore, serves two major purposes:

1. The enrichment of many areas of experience and content in subject matter fields
2. The discovery of interests, abilities, and aptitudes of the individual related to industry

Elementary industrial arts is an area of instruction which makes a distinct contribution to the ongoing elementary program through its own subject content, methods, and techniques. It helps to clarify the concepts encountered in social studies, language arts, science, and arithmetic. The interest in the activity provided by the program usually creates additional motivation for the acquisition of knowledge and skills in other instructional areas. Industrial arts also has subject content of its own which relates to the highly industrial society of today. Fundamental skills, social studies, play experiences, personal and seasonal interests, and the challenge of environment provide many opportunities for the use of industrial arts skills and practices.

This elementary industrial arts program stresses construction activities and the proper use of tools and materials that grow out of pupil needs and interests through planned activities as well as furnishing opportunities for necessary psychological and social adjustments and for the development of desired manipulative skills.

Another group of educators places emphasis on the ways man through the ages and in every culture has changed the materials of his geographic environment to satisfy his physical needs for food, clothing, shelter, tools, utensils, weapons, transportation, communication, and records. As a study of the work of mankind, industrial arts has a sound basis as a major part of many integrated curriculum units by helping the child to realize that from man's efforts to satisfy his physical needs came the additional need of acquiring skills in the use of measurement and number, the sciences, language arts, methods of research, recording and communicating; in fact, most of the subject-matter content found in the school curriculum of today.

Through engaging in the actual work processes considered essential by man engaged in meeting his requirements for food, clothing, shelter, and other basic needs, the child identifies himself with the work and the inherent problems of the people engaged in doing the work. The result of these experiences is the development of a more sympathetic understanding of the people who do the work of the world, a humane interest in, and an appreciation of, man's achievements in industry, and a set of values which contributes to the acquisition of intelligent consumer practices.

This emphasis recognizes a distinction between crafts, construction, and industrial arts on the basis of the child's purpose for engaging in the experience. A first grade child, through making a house from a wooden box or other materials for play, is engaged in acquiring initial understandings, meanings, and concepts identified with the actual process by which the adult satisfies his shelter requirements. Limits of his capabilities for performing the actual adult process prevent him from building a real house. The extent to which the primary grade child uses what he has constructed in play determines how he will build the desired meanings and understandings inherent in the industrial processes. This is the only way in which the child's construction is related to industrial arts as such.

The performance of the actual industrial processes is limited for the child in the primary grade to those processes which have been the most simple for man himself through the ages, such as the processing of foods or the making of utensils from clay. Through these simple activities the child may experience the real process. Here the child actually uses the real materials and tools in the real ways of the home and the bakery to make bread, cakes, cookies, and the like, or by taking clay, working it, and shaping it to make a plate or bowl. To gain the desired meanings, concepts, and understandings, the original process must at times be modified to fit the capabilities of the children at a given maturity level.

Although it is sometimes impractical to perform the real processes, as in the situation described for the first grade child needing to build a play shelter, a child who has the opportunity to construct a play house from a wooden box will become purposefully involved in selecting the kind of shelter required for the situation, selecting materials appropriate to the construction, and the tools necessary; planning placement and sizes of doors, windows, and facilities to serve the pipe-cleaner dolls or other toy occupants. He builds the structure in accordance with his

personal likes and reveals in his construction his awareness of the ways of the culture in which he lives. He must do the work and overcome the difficulties of construction as they occur in order for the end product to be useful and satisfying to him. He thereby identifies himself as a worker in the world and arouses in himself a sympathetic understanding and appreciation of all persons upon whom he depends for the worth-while things of life.

The real measure of the value of the experience is in the process rather than the end product. True, the product has satisfactions for the child, but the process involves the real learnings which come about through problem solving, specific learnings, enjoying the work of others, and the joy of production.

All Children Need Industrial Arts Experiences

The important item agreed upon by all educators regardless of their belief in the emphasis in industrial arts is that children should have opportunity to participate in industrial arts experiences. Industrial arts experiences are on-going; they arise from previous experiences and contribute to further experiences. Here is an area which has a rich contribution to make to each child. A good industrial arts program can accomplish the following for pupils:

1. Deepen their understanding of the content of any instructional field
2. Provide enrichment activities and experiences which clarify thinking, extend knowledge, and supply meanings which build desired concepts
3. Motivate to further study and create new interests
4. Create opportunity for functional use of language, science, and arithmetic skills
5. Give growing children opportunities to develop physical coordination
6. Provide opportunity for children to work together co-operatively and thus to grow socially
7. Provide for wholesome creative outlets for children
8. Provide for emotional growth through satisfaction found in planning and creating
9. Develop appreciation for the dignity of labor, the skill of the craftsman, and the problems of our industrial society

Elementary industrial arts experiences develop pupils' abilities in the following ways:

1. Expressing self through the creation of material objects
2. Planning the construction of objects or reproducing processes in a logical manner
3. Solving problems in the construction of objects
4. Using tools and materials wisely, safely, and with reasonable skill
5. Working with tools and materials for practical purposes
6. Appreciating a job well done

Objects made as a part of industrial arts activities should serve a real purpose. These objects or projects should not be ends in themselves nor should they be elaborate or too time-consuming. The construction of a specific object need not involve all the pupils in a single class. The teacher should stress good construction and craftsmanship. Naturally these should be in terms of the maturity level of the group. Children will gain an appreciation for good work if they have the opportunity to experience teacher guidance in establishing the highest standards of which they are capable. The ability to use materials successfully, to create and to obtain successful results, gives a child a feeling of satisfaction that may not be possible for him in other fields of instruction. The personal satisfaction of work done to the best of a child's ability and carefully evaluated, often leads to the improvement of his general work habits and standards.

Industrial Arts Experiences Adapted to Maturity Levels

From kindergarten through sixth grade, the main emphasis in industrial arts will probably be in making those items and performing those processes which do most to help children to acquire important meanings and understandings necessary to comprehend the rapidly changing world in which they live.

In the seventh and eighth grades, particularly where the school provides shop facilities, the main emphasis in industrial arts may be that of a separate subject area although there will still be opportunity to relate industrial arts to integrative curriculum units. Here, each child may have the opportunity to select the particular area of industrial arts which suits his interests and desires. Within the industrial arts field, whether it be woodwork, metalwork, or electricity, each child should have the opportunity to select the construction of, or making

of, a worth-while object of his choice in terms of his capabilities. The teacher's guidance in making this selection is highly desirable, but the particular project should not be imposed by the teacher.

At the upper grade level the industrial program can continue to enrich and deepen the offerings in other subject fields. Instead of written reports in social studies or science, the child may construct models or other objects which serve to clarify thinking. The opportunity to work in this manner will serve as a strong motivating force for many children and lend additional interest to other fields of instruction.

Industrial Arts in Total Educative Experience

Industrial arts is recognized by most educators for its unique contribution to the educational program of the public schools. The importance of man's ingenuity to the development of our present civilization is an understanding children should acquire. They should discover through many experiences that it has taken man a long time to arrive at the ingenious solutions he has found for his problems. Nearly all recognize that machines, tools, and materials wisely and skillfully used are a creative force for good. Such understanding is essential in building an understanding and appreciation of the resources of the world, man's use of them, and the problems of the people who work with them. It further places in proper perspective the relation of fine arts to the industrial arts, so that the child may come to see that beauty should be a part of every object. Through a sound industrial arts program, the child may realize that such materials as the clay of the earth can be more than mere mud on the feet. It may become a crude adobe brick, a beautiful ceramic bowl, or a fine statue, depending upon man's awareness, ingenuity, and "know-how" in using the raw materials of his geographic environment to satisfy his needs and desires.

INDUSTRIAL ARTS IN THE CURRICULUM

Industrial arts provides girls and boys with understandings of the physical environment of the world and its effects upon man's way of living. Industrial arts also helps pupils understand how man's way of living affects his environment. Such study is essential if girls and boys are to understand the foundations on which the present-day cultures of the United States and other countries have been built. If children are to live freely in today's world and if they are to contribute to an increasingly better world, they must understand and appreciate what is happening to their environment and how the past has contributed to the present. Through guided participation in industrial arts activities, girls and boys in today's schools are helped to gain desirable understandings, appreciations, and skills.

Early Industrial Processes Learned in Homes

Schools of the United States have not always needed to be concerned with industrial arts education. When tasks essential for meeting individual needs were accomplished almost entirely at home, on the farmlands surrounding the home, or within the local community, children could easily understand and appreciate the processes and social problems of the people involved.

Prior to the second half of the nineteenth century, children in the American culture participated extensively in providing for the material needs of their families. Their work included helping to harvest and conserve fruits, vegetables, and grains. They peeled the peaches and apples and stirred the jam. They cut the fruit and turned it as it dried in the sun. They gathered sap from the maple trees in winter and stirred the boiling syrup in the vats. They churned the cream to make butter and worked the whey from the curds of cottage cheese. They gathered wood for fires to smoke the meat. They watched the yeast culture multiply, saw its effects upon the rising bread dough. They watched, and helped their mothers knead the dough to an even texture. They learned from direct experience where their foods came from and the work that went into the food's preparation. They saw how people depended upon each other to provide food for the family's consumption.

Girls and boys learned about the primary source of their clothing and how nature's raw materials were changed into wearing apparel. They saw sheep raised and sheared, cotton and flax grown and harvested. They helped to wash the wool, to card and spin it. They saw the flax and cotton processed into thread—and sometimes participated in the processing. They collected berries, roots, bark, and plants to use for dyes, and saw the effect of the different dyes on drab materials. They knitted stockings; saw beauty woven into fabrics from which clothing was fashioned. They helped to leach the lye from ashes, to mix the lye into the fat and to stir the thickening soap with which their clothing would be washed. They helped to scrape and tan the hides from which shoes and jackets were to be made.

Even young children watched houses grow from tree to latch string and saw the men in their family and in the neighborhood work together to provide shelter for each others' families. The children dipped candles, saw furniture made, spoons molded. They plucked fowl and washed and dried the down for pillows and featherbeds.

Children watched their fathers whittle oxen yokes and trenchers, listened to the tunes played on homemade willow flutes, and tried their hands at making whistles and drums. They saw the bullets drop from iron molds, saw pouches made of tanned deerskin and powder poured from polished horns. They listened to the anvil clang in the blacksmith shop, saw horses shoed, and nails and wagon hoops hand-hammered into shape.

Through the experiences of every-day living, young people learned of man's dependence on nature and each other. They developed initiative and learned to work with other people in co-operative endeavors; learned to carry their share of the load, and to appreciate the contributions of other workers to group projects. They grew in understanding of, and appreciation for, the organizations and activities involved in making a living. It was not difficult for the girls and boys to understand that people in other parts of the world and at other times in history participated in similar activities to satisfy their physical, esthetic, and spiritual needs.

Slowly through the years the innovations of science and invention changed man's way of life. Man's dependence on the natural elements of the environment has continued; in many cases, however, methods of controlling these materials have changed. Many industrial processes, which once were done by hand in simple ways, are accomplished today

by complex machines. Many raw materials, once thought to be indispensable, are gradually being replaced by synthetic substances made possible by chemical discoveries. Technological developments and the social changes which have accompanied them gradually have made a large per cent of the people of the United States almost entirely dependent upon the efforts of other people for materials with which to meet their basic physical needs.

Opportunity of Today's Children to Learn About Industrial Processes

American children today have little opportunity in the home to develop understanding of the ways men have changed and continue to change raw materials to provide for their needs. There is little opportunity for them to have the personal satisfaction which comes from creating needed materials by hand.

Although home canning, drying, and freezing are still used to preserve foods, grocery stores and bakeries provide the foods to meet most food wants. The processing of foods is generally accomplished in canneries or factories far removed from the home.

Although many women continue to sew, department and clothing stores supply the ready-made garments worn by most people. Weaving, once a preliminary step in making clothes, has now become a hobby, and one seldom hears of wool being washed, carded, or spun at home.

Houses frequently come prefabricated or spring up quickly on a production-line basis, with each worker performing a specialized task. Synthetic building materials resemble little their original sources. Interdependence continues to be necessary, but the warmth of personal contact between child-observer or child-helper and builder cannot exist. Wage scales allow no time for the carpenter to explain to the watching child the "why" and "how" of his work. Nor is opportunity provided for the child to gain understanding through active participation as a helper.

Tools, utensils, weapons, and vehicles of transportation and communication are readily available at retail stores. The child knows little or nothing of the planning and labor which have gone into their construction.

Not only does the youth of today miss taking part in processing raw materials into useful forms, he does not see the relationship of his and neighboring family members to the tasks involved in the processing.

As a result, he has little opportunity to develop a true understanding of the importance of nature's raw materials to the satisfaction of his basic needs; he cannot easily understand and appreciate the problems, ingenuity, contributions, and interdependence of the people who produce and distribute the materials people need. It is likewise difficult for him to appreciate the contributions of past generations to the comforts of today's world. He cannot learn at first hand his responsibility for conserving and replenishing nature's stored goods.

Children in the Modern School Helped to Understand Industrial Processes

The school has assumed its share of responsibility for helping children to gain better understanding of, and appreciation for, the materials in their environment, for the people who do and have done the work of the world, and for the problems involved in changing the materials to more usable forms.

It is most desirable that children have available for processing raw materials such as raw foods, natural fibers from which textiles and articles of clothing are made, logs from which lumber is cut, vegetation from which synthetics are derived, and the metallic ores, clays, and other materials of the earth. At times, however, raw materials cannot be used by children and semiprocessed materials must be substituted. It may not be practical for the children to grind enough wheat or corn into flour or meal from which to make bread or piki for the group. The girls and boys may not be able to refine as much native clay as would be needed for the bowls they want to make or to render enough tallow for each person to make a candle. Young people in school cannot successfully pasteurize raw milk before they change it into cottage cheese or butter; nor can they smelt the ores from which to pound pewter or copper bowls. They cannot make baking powder, evaporate sufficient salt water to obtain salt for their cooking, or process the raw cotton into cloth from which to make sunbonnets.

The children should, however, grind enough corn to make some piki or corn bread, process enough native clay to complete a bowl, render enough tallow from which to dip or mold a few candles, process a little cotton, wool, and silk, evaporate a little salt water. By so doing they gain understanding of the basic principles of the process, and so may be guided to use with understanding and appreciation the commercial products needed for quantity production of objects and materials.

Occasionally it is necessary for children to use substitutes for authentic materials. For instance, if grasses and stalks such as those used by the Hopi Indian cannot be procured, commercially prepared reeds and raffia may be used. The children make their baskets in the same way that the Indians wove baskets from the materials of their native environment. They are made aware of differences between the substitutes and the original materials.

Every area of experience in the curriculum offers opportunities for children and youth to process materials as they are or have been processed by the people of the world. Every area offers teachers opportunity to guide children to appreciate the problems of the world's people as they are or have been involved in such processing.

Industrial Arts in Primary Grades

In the primary grades the performance of the actual industrial processes is limited to those processes which were the most simple for man to evolve. Young children use the real materials and real tools in the real ways of adult workers as they process the materials.

Children engage in the following activities relating to the processing of materials. The girls and boys make soup and stew from vegetables grown in their own gardens and from produce purchased at the grocery store or market. They make simple salad dressings to serve on vegetables from their gardens. They roast and salt the peanuts they have grown, bake apples they have picked and potatoes they have dug. They boil eggs which their carefully tended hen has laid; dry raisins, grapes, figs, and peppers. They combine pasteurized milk and cream with other ingredients to make custard, ice cream, butter, cottage cheese, and junket. The children wash and wax oranges; make marmalade.

Some corn is popped; other corn is dried and ground into meal from which to make piki or corn bread. Children watch corn bread rise, see it turn brown. They note the leavening action of the home-grown yeast, and compare it with the action of soda and baking powder, which they put in their biscuit and rye-bread dough. Pemmican or rabbit stew made by the children adds zest to an Indian meal.

The girls and boys weave small rugs for their houses, make dye from the minerals and vegetation found in the local community, and dye cloth. They build miniature pueblos, hogans, and teepees from authentic raw materials; wash, card, spin, dye, and weave wool as the Indians did and do. They gather, prepare, and mix clay, fashion

and decorate pottery from the clay, and bake it in the way of the Indian or other cultures.

Children in the third grade carve rabbit sticks, make and weave on Indian band and rug looms, dry and soften rabbit skins to use as drum heads. From cottonwood and sheep or rabbit skins they fashion drums. They carve and decorate kachina dolls, make rattles, rain sticks, and prayer sticks, sew dresses and kilts, and weave baskets from grasses and reeds.

Industrial Arts in the Intermediate Grades

In the intermediate grades the girls and boys process the food of the time and place they are studying. They can some fruits, and dry fruits, meats, and vegetables. They extract the salt from salt water and use it for preserving and flavoring foods. They press oil from olives; make cheese, butter, jam, succotash, hasty pudding, and hominy, and bake beans. They grow, harvest, dry, and grind corn to use in making tortillas, hoe cake, masa, and corn bread; they grind acorns for acorn mush as the early California Indians did. They plan, prepare, and eat meals such as those eaten by the people whom they are studying.

From authentic raw materials, girls and boys of the middle grades make adobe brick and tile. They build miniatures of the ranch houses and missions of early California, log cabins and other houses of colonial days, dugout homes, lean-tos, half-face camps, sod houses, Swiss chalets, Andean huts.

They braid rope from llama wool, make quipus, carve gourd dishes, pound out copper bowls, fashion pottery. They process cotton, flax, and wool, knit some of the yarns, and weave other yarns. Some of their cloth they decorate with block-print designs typical of the culture studied. From commercially processed cloth they piece quilts, braid and sew rugs, sew samplers, and make clothing patterned after that worn in the culture they are studying. They make candle wicking and dip and mold candles from tallow they have melted from the fat of beef and mutton. They extract lye from wood ashes and combine it with rendered fat to form soft soap.

From sheep or goat hides which they have tanned, children of the middle grades create parchment from which to fashion scrolls and hornbooks. On the papyrus and paper which they process they write in ink and with the pens, both made by the children. Clay and wax tablets are formed from raw materials and inscribed with authentic

styluses. On hand-made vellum the girls and boys inscribe manuscripts as did the medieval monks.

The children gouge trenchers and spoons from blocks of wood, and carve trenchers, dippers, and water jugs from gourds. They construct box and tape looms, three-legged stools, cradles, and leather-thonged beds. They make powder horns and shot pouches as their forefathers did.

Industrial Arts in the Upper Grades

As preadolescents become acquainted with the cultural backgrounds of the people of America, they process many materials. They cook foods, process textiles, and make clothing peculiar to the ancestral homelands of the various peoples who comprise the population of the United States. They dress dolls in native costumes and make miniature dwellings of the cultures studied. They make some musical instruments of materials and in the same way as the people of the countries being studied. They engage in handwork similar to that done by the people of the particular culture.

The study of American agriculture in its relation to that of other countries presents opportunities for processing. Major grains are hand ground, their flours used in making breads, and these products are compared with each other and with the products of the modern baking industry. Agricultural products of the United States are preserved or cooked and eaten; well-balanced meals are planned and prepared. Foods that compose the diets of the peoples of various countries are prepared and eaten and are compared with the foods that compose the well-balanced diets of the local cultures.

The pupils remove the fibers from silkworm cocoons, reel the silk on spools, twist it into threads, and attempt to weave it. If the upper grade pupils have not processed cotton, flax, and wool in earlier grades, they do so now. They knit the yarns and sew with the threads. Batik work and block printing extend their experiences. They bind books which they have written, cure hides and tan leathers, and experiment with natural dyes. They process clay into useful and beautiful articles.

The Importance of Construction Activities

Construction activities are integral parts of the broad integrated curriculum units. Construction activities become necessary as children make articles for dramatic play or dramatization or make articles to illustrate—in diorama, timeline, or oral presentation—historical events,

inventions, or industrial and social processes of importance. Frequently it is impossible for children to create the desired articles of the same materials and in the same manner in which the original was fashioned.

The products constructed are shaped and painted by children in the primary grades to assume the appearance of the objects they represent, but the children know they are not the same. Guns and transportation models made of wood and painted to look real are sturdy and adequate for purposes of dramatic play. The framework of large buildings is constructed firmly of wood. The walls of heavy wrapping paper or cardboard take on the appearance of the structure they represent as they are painted in accordance with information gained through reading.

In the intermediate and upper grades through reading the children learn how, why, and of what the original products have been made. They learn something of the people who work to create the original objects. Their deepened understandings endow the items made by the children with the character of the original for purposes of dramatic play or dramatization.

As children play with the objects they have constructed and gain information to make their play real and satisfying, they find needs for further construction. So it goes. Play gives purpose to construction and the constructed articles in turn enrich play. Because dramatic play is the most dynamic force which moves a study forward, construction plays an important role in each area of experience studied.

The very young child who has had no previous experience with tools and wood usually spends much time in pure manipulation, perhaps in pounding nails into boards with no end product in mind. He may enjoy pounding nails into and fastening bottle tops onto short pieces of soft pine which the teacher has retrieved from the waste piles of cabinet shop or planing mill. Tools suited to the child's ability add to the enjoyment and satisfaction of the process.

Later on, the child may nail two or more boards together. The product is suggestive of what the child is constructing, but is not complete or accurate. He may give his constructed object a name if it resembles some known product. He may take the object home the same day he makes it, just as he does some of his painting and clay work; or he may keep it at school to use in solitary or parallel play, or even for a transitory bit of small group play.

Before many weeks have passed the child begins to make objects to supplement those placed in the environment by the teacher. As the

child is encouraged to use his constructed object in dramatic play, he finds that other people attach value to his creation. In time he may be willing to construct objects for use by other children and become willing and eager to leave the articles at school so that play will be more fun.

As the child matures, he becomes more able to plan with others to construct the items needed for satisfactory group play; he helps to construct the articles even though he may prefer to work on a different project. Still later, he works with one, two, or more classmates on a single item to which each worker contributes ideas and labor.

Models sometimes are built to illustrate a process or a socially significant historical event. Dioramas may depict events of economic and social importance; and sometimes a series of dioramas serves a timeline. Through constructing the objects, pupils are helped to organize the information they have gained. They use the constructed objects as they use other visual aids to illustrate their explanations of events or processes. In this way the objects serve as resource materials for other people. The use of models and dioramas is more prevalent in the upper than in the primary and intermediate grades.

Studies of every area of experience are enriched and extended by construction of properties for dramatic play. In the primary grades the items are usually small and give many children opportunity to play at one time. As the children play with the buildings and vehicles of their communities they learn the relatedness and interdependence of the various structures and services within the community. As they rotate jobs during dramatic play, the children begin to see, feel, and understand the importance of all persons to community life. Many social and intellectual learnings are reflected in the children's behavior as they construct and play with their products.

Primary Construction Activities

Primary children make such items as the following:

Houses and their furniture and furnishings.

Trucks used for hauling light loads in the local community and heavy loads to and from distant places; facilities for storage, loading and unloading, servicing, and repairing the trucks; stop signs, stop and go signals.

Trains for carrying passengers and freight: engines and the cars they pull—passenger, sleeper, baggage, mail, box, flat, gondola, refrigerator, stock, and tank cars, caboose; depots and freight stations with

hand trucks, baggage trucks, and freight trucks; roundhouse with turntable; freight warehouses; water and oil columns; sand tower; signal block, semaphore and wigwag signals, and crossing signs.

Airplanes for carrying passengers and freight; airport facilities—hangars, administration building; control tower; weather station; wind socks or tetrahedrons; gasoline, mail, fire and food trucks; beacons.

Boats and ships that use the local harbor and the other facilities of the harbor that are related to the boat's use: tugboats, freighters, lumber boats, ocean liners, oil tankers, ferry boats, pilot boats, fire boats, fishing boats; docks, warehouses, bridges, breakwater; lighthouse, trucks, jitneys, and cranes.

General community buildings: wholesale and retail food markets, bakery, service station, bank, school, theater, fire station, post office, furniture store, lumber yard, dress shop, shoe store, library, church, restaurant, drug store, industrial plants, the furnishings needed for each building, and the materials sold or manufactured in them.

Specific community buildings: bakery shop with counters, display cases; wholesale bakery with machinery, flour mill, foodstuffs; trucks to transport food; wholesale and retail market: buildings with counters and shelves, vegetables and fruits, cash register, turnstile, scales, refrigerator, bags, boxes, crates; stake, huckster, clamp, and hand trucks; post office: pigeon holes, mail bags, mail truck, cancelling stamp, mail boxes, mail deposit box, trains, airplanes, helicopter, boat.

Children construct objects needed for dramatic play as they study life on the dairy farm and general farm. Some of these follow.

General farm: farm house with furniture and furnishings; hay barn, milking barn, chicken pens and coops, pig pen, tool shed, silo, feed store; hay, cattle, stake and pick-up trucks; disc, plow, harrow, fences, toy animals, and toy people. Sometimes they make pens out of doors in which to house live farm animals.

Dairy farm and creamery: farm house, milking barn with stanchions, pasteurizer, bottling plant; creamery; calves' nursery, feeding troughs, silos, fences, grain sacks, hay and milk trucks, toy animals, and toy people.

Life studies, such as those of the Indians explored in the third grade, lend themselves to the construction of large objects. Since life studies generally center around the home, third grade children may construct and furnish a dwelling representative of that occupied by the Indians

being studied. Clothing and utensils are made. As play takes in other facets of Indian life, facsimiles of weapons and utensils need to be constructed.

Construction Activities in the Intermediate Grades

The same type of objects constructed in the primary grades are important for intermediate grade studies of the distribution and production of goods. Through play with the small-scale models, children grow in understanding of some of the complex and interrelated aspects of the industries.

Life studies continue to call for construction of large objects with the house and its furnishings receiving much attention. Children's play is given meaning by the construction and use of weapons, tools, clothing, transportation, and communication media. All construction is accompanied by other learnings about the people involved.

The list which follows is suggestive of items that may be constructed for studies in the middle grades.

Early California: ranch house or veranda or patio of ranch house, furnishings for the house, veranda or patio rugs, curtains, tables, benches, bed, fountain, dishes; outdoor oven, carreta.

Modern California: models of transportation vehicles, such as airplanes, trains, automobiles, trucks, ships, and the facilities used for the storage, repair, and servicing of the vehicles and safety devices designed to control their movements; model of oil derrick and oil field, models of industrial plants; dioramas to show growth of industry and tasks involved in producing foods, clothing, and other life essentials.

Ships: ship models, cargo, harbor with facilities for mooring, repairing, servicing, and launching ships, safety devices, such as buoy, lighthouse, fog signals; docks with unloading and loading devices; warehouses and canneries; community buildings and transportation devices related to harbor activities; dioramas of the story of oil, lumber, and the fishing industry.

Freight trains: diesel and steam engines and the cars they pull; models to indicate the history of freight train transportation; freight carried; loading, unloading and storage facilities; buildings and vehicles related to the production and distribution of freight.

Colonial Life: part of a colonial fire room; furniture for the fire room—bench, cupboard, flintlock rifles, bed, farm implements—plow, flail, scythe; Betty lamps, pipestem-cleaner people and their clothing.

Pioneer Life and Westward Expansion: pioneer fireplace and inside cabin wall; furniture—benches, stools, cradle; farm implements—plow, rake, scythe, pitchfork, axe; candle holders, butter churn and paddle, covered wagons, flatboat.

Canada: transportation models—airplanes, trains, automobiles, trucks, ships, dog sleds, snow shoes; models of power producing plants; model to show the growth of agricultural products.

Latin-American Neighbors: farmer's house; furniture, furnishings, and utensils for the house; musical instruments, farming tools and implements; models of modern and primitive towns within the area studied.

Aeronautics: models of commercial airplanes, of gliders and balloons; model airport with facilities—hangars, control towers, weather bureau station and such equipment as barometer, anemometer (wind gauge), rain gauge, weather vane, hair hygrometer, nephoscope, airplane instruments.

Communication: furniture and equipment for newspaper office; telegraph key and buzzer set; telephone communication system, using telephone supplied by the telephone company; broadcasting booths for radio and television stations, crystal sets using crystal only, using crystal and selector coil, and using transistor, electromagnet.

Construction Activities in the Upper Grades

In the program of the upper grades construction continues to be used.

Business in the Community: community buildings, telephone switchboard, telephone poles, materials for science experiments.

Agricultural America: water gauge, barometer, anemometer, wet-dry bulb thermometer, seed boxes, weather station, hair hygrometer, weather vane, model farm, models showing contour farming; reforestation measures, modern logging camp, windmill, water wheel, steam turbine wheel, wind velocity indicator.

Industrial America: dioramas and models to illustrate historical events and processes involved in major industry studied, such as dioramas of a modern oil field showing life during prehistoric times and the sequence in the story of oil; models of open pit mine, of shaft mine, of steel mill.

Industrial Arts as Specialized Courses in the Upper Grades

Although industrial arts continues to contribute to the broad curriculum areas throughout the elementary grades, in some schools industrial arts for the seventh and eighth grades is a special subject matter field and special facilities are provided for teaching it.

The specialized industrial arts program in such schools is generally divided into six categories, which, together with activities appropriate for each area, are as follows:

Drafting and industrial drawing: general and technical sketching, instrument drawing, lettering, shape description, diagrams, graphs, maps and charts; and reproduction of drawings.

General woodwork: gathering general and related information; planning, drawing, and estimating; making layouts and measurements, studying the care and use of hand tools; holding, cutting, drilling, boring, and driving; operating machine tools. Using mechanical fasteners and hardware; assembling and finishing products; and studying about safety and shop personnel organization.

General metal work: gathering general and related information; planning, drawing, and estimating; making layouts and measurements; learning about the use and care of hand tools; doing sheet metal work; doing bench metal work; soldering; operating machine tools; casting and forging metals; working with mechanical fasteners and hardware; fabricating, assembling, and finishing items; and learning of safety and shop personnel organization.

Electricity: gaining knowledge of theory and related information; planing, drawing, and estimating; studying about the care and use of hand and power tools and the care and use of meters and instruments; wiring, constructing, installing, checking, and testing electrical devices; measuring and operating electrical appliances; repairing and maintaining the devices; experimenting with electricity and electrical instruments; and learning about safety and shop personnel organization.

Handicrafts: planning, drawing, and designing; doing layout and measurement; learning about the care and use of hand and power tools; cutting, assembling, and finishing materials; braiding and weaving materials; working with plastics and leather; working with clay and lapidary instruments; and learning about safety and shop personnel organization.

Graphic arts: planning, designing, and estimating; working on hand composition; experimenting with imposition and press work; doing silk screening; experimenting with photography; doing relief and intaglio work; binding books; and learning of safety and shop personnel organization.

In all of these courses, much emphasis is placed on affording opportunities for students to express themselves creatively, within the limits set by the principles of good design. Safe work habits and good methods of construction are stressed. Planning, as it applies to the useful object that the pupil has selected to make, is continually emphasized.

Objectives of Specialized Courses in Industrial Arts Education

Objectives of specialized courses in industrial arts follow:

To satisfy the creative desire in youth to construct something with tools and materials

To develop the ability to apply the skills of measuring and calculating and to use scientific information, graphic illustrations, and reference materials

To develop ability to plan and work alone or in co-operation with others toward the orderly, efficient, and complete performance of assigned and selected tasks

To develop appreciation for good design, construction, and craftsmanship

To discover and develop personal aptitudes, interests, abilities, self-reliance, and resourcefulness through problem-solving and self-expression

To enrich other instructional areas by bringing theory and practice closer together through illustrations and practical applications in the construction of useful articles that enrich personal and group living

To develop understanding of conservation and the sources of the basic materials that provide resources for man's comfort, health, and enjoyment

Shop Facilities in Schools of Various Sizes

The recommended number of shops, types of shops, and areas of industrial arts that may be provided based upon enrollments in grades seven and eight are set forth in the following paragraphs.

For schools with seventh and eighth grade enrollments up to 250 pupils, there should be one comprehensive general shop in which industrial drawing, electricity, general metalwork, and general woodwork are taught.

For schools with seventh and eighth grade enrollments from 250 to 500, there should be a metal shop in which general metalwork, including activities in electricity, are taught and a wood shop in which general woodwork, including industrial drawing, are taught. In schools of such size, handicraft activities may be introduced in appropriate courses.

For schools with seventh and eighth grade enrollments from 500 to 750, a metal shop, a wood shop, and an industrial drawing shop should be provided. Metalwork, woodwork, and industrial drawing are taught in the appropriate shop; graphic arts activities are taught in industrial drawing courses; and handicraft activities are introduced in appropriate courses.

A metal shop, a wood shop, an industrial drawing shop, and an electricity shop are recommended for schools with from 750 to 1,000 upper grade students. Appropriate graphic arts activities may be introduced in the industrial drawing courses, and handicraft activities may be introduced in appropriate courses.

In addition to the activities classified as industrial arts in the above preceding section, much processing of raw and semiprepared materials is performed in such courses as homemaking, sewing, home management, and science.

Outcomes

Any activities undertaken in the school should produce desirable outcomes in terms of pupil growth and development. The industrial arts education promotes growth in social relationships, in understanding and knowledge, in esthetic judgment and appreciation, and in the development of motor skills.

Growth in Social Relationships. As girls and boys are helped to process materials and to construct articles by themselves and in cooperation with their peers, they grow in respect for other people's rights. They are guided to learn that they can spend a more profitable time in actual work if they participate in planning, clean-up, and evaluation periods. They are taught not to take space, tools, or materials which rightfully belong to others. They learn to ask the one using a tool or some material for permission to use the one they need. They learn that they cannot use certain materials that others need in completing work

they are doing. They come to realize that they must not destroy articles being made or materials being processed by other children. They learn to be considerate of the feelings of those to whom they make suggestions for improvement of work.

Children are helped to grow in ability to choose wisely from available materials so that finished products will be as they desire them, and so that materials needed by others will not be wasted.

Habits of co-operation are strengthened as girls and boys are given many opportunities to share materials, tools, ideas, time, and space; as they are encouraged to let other people use products which they have made or to which they have contributed; and as they are permitted to use the products others have made. They gain a feeling of belonging as they work with their peers in creating needed objects. Through guided participation in many group enterprises, children learn to do their share of the work in co-operative projects and to be accurate in the work they contribute. They learn to adapt their ideas and wishes to group-conceived plans.

Children learn to assume and fulfill responsibility as they construct. The child who makes a filling station and adds it to the model of a community or completes a diorama, recognizes the importance of his contribution toward completing a task. As he continually checks his opinion against facts in order to be successful in his activity, he realizes more fully the importance of verifying data and basing his work on valid information.

Children grow in self-esteem as the products of their efforts are accepted and used by their peers. They grow in ability to take suggestions and criticism cheerfully and thoughtfully as they achieve success and gain satisfaction from work well done.

Children grow in independence and self-confidence as they achieve success. At the same time, they are helped to recognize with increasing vision their dependence on others and the dependence of all people on nature and on one another. They improve in understanding of the simple relationships of co-operative living.

Growth in Understanding and Knowledge. As girls and boys constantly meet and are helped to solve individual and group problems of varying degrees of difficulty and complexity, their understandings are clarified, deepened, and broadened. They learn about the kinds and sources of materials used, the unique potential of each material, and why certain raw materials are chosen for making particular prod-

ucts. They learn the principles governing the processes by which materials are changed to more usable forms and the use to which the finished products are put. They learn of people's dependence upon each other and upon the physical resources of their environment. They become aware of the working conditions of the people who produce various goods. They learn something of the problems of management and labor, supply and demand, and of the laws established to insure fair treatment for employer, employee, and consumer. They see how the products of modern industries promote men's physical and mental health. They learn of the need to provide for the wise use of the increased leisure which has resulted from modern industrial development.

Children may become sufficiently interested in a process to continue it as a hobby or ultimately as a career. They may develop a continuing interest in the changes and progress of industry and read with understanding newspaper and magazine articles and industries. They should become increasingly more skillful purchasers and appreciative consumers of the goods of industry. The extent of knowledge and understanding developed in the field of industrial arts varies with the maturity and experiences of the children involved. An illustration of each development follows.

A group of children had been vitally interested in managing and publishing a school newspaper. Their interest in the development of the paper led them to do research about the discovery of paper and the early history of its manufacture. The group read about preparation of papyrus by the ancient Egyptians. Many books, maps, films, and other audio-visual materials were used to find accurate information.

The entire group of 35 girls and boys worked together to cut, pound, and dry the papyrus. They worked hard and with genuine interest. They wrote hieroglyphics upon the surface and expressed an appreciation for the untiring efforts of the contribution of the Egyptians to paper manufacturing. They compared the processing and use of papyrus to modern methods of making paper. They felt that this rich experience had given them not only an understanding of the processes used by the ancient Egyptians, but also an understanding of how modern methods have facilitated the production of newsprint and other kinds of paper.

The research which accompanies construction of objects contributes to intellectual growth. As children engage in research which will

help them to build airplanes, construct verandas, and design Inca jewelry to use in dramatic play, and as they make these items, they develop an increasingly deeper understanding of the people about whom they are studying. Working out sound effects for their radio script, making a telegraph key, weaving on a box loom, or building a model of Boonesboro demand the gathering of information which may clarify meanings and understandings. Through experimentation with ships which they have hollowed out of blocks of wood they learn something about buoyancy and balance.

Growth in Esthetic Judgment and Appreciation. Through industrial arts, girls and boys become aware of the potentialities inherent in each type of material with which they work. They learn the possibilities of working with clay, how it can be molded, shaped, carved, and welded, or thinned to "slip" consistency to pour into a mold. They learn that it hardens, can be glazed, fired, and changed into permanent form. They learn that wood can be cut, carved, polished, glued, and nailed.

They become acquainted with the qualities of various metals. They discover that pewter can be readily molded by hammering, that copper is more difficult than pewter to shape, and that tin is easy to cut and solder.

Through guided experiments, they find that textiles can be bleached, dyed, painted, woven, braided, or knitted, crocheted, embroidered, cut, and sewed. They learn that each time a change is made in the form of a material, that the material becomes more or less beautiful.

As children grow in the understanding of the materials with which they work, they are encouraged to develop ingenuity in their use of the materials. They explore and discover new ways of working. They begin to create new designs. As they are guided in experimenting with materials and in examining the products of other people's endeavors, they learn that even industrial products of a utilitarian nature may be made pleasing in design, texture, color, or a combination of these qualities. Through these experiences they may learn to be discriminating in the choices they make.

Growth in Motor Skill. Children develop motor skill as they use the tools in processing and construction. The concreteness of the product and the satisfaction gained from its use encourage the children to work carefully. Eye-hand co-ordination is improved as children draw plans, cut along lines, pound nails accurately. Tools and materials are

provided and guidance is given in terms of the developing physical skill of the children.

Many children, who are less successful than others in verbal expression, may find that they can express themselves effectively through concrete materials and so come to improve their self-concept. Certain children who excel in academic learning learn to have genuine respect for children who have greater competence than they in handling tools and producing objects of satisfying quality. All types of abilities are needed in the complex world in which children are in the process of finding their way, and the school which serves them well is one which values the unique potentialities of each individual and provides opportunity for their nurture.

Learning That Takes Place Is Real Measure of Activity

In all industrial arts activities, the real measure of the value of the experience is in the learning that takes place. True, the product resulting from the activity has satisfaction for the child, but the activity involves the real learnings which come about through problem-solving, enjoying the work with others, and the joys of production. The child has to examine and to select the kind of shelter required for the situation, to select materials appropriate to the construction, and the tools necessary; to plan placement and sizes of doors, windows, and facilities to serve the pipe-cleaner figures or child occupants. He builds the structure in accordance with his personal preferences and in relation to his awareness of the ways of the culture in which he lives. He must do the work and overcome the difficulties as they occur in order for the end product to be useful and satisfying to him. He thereby identifies himself as a worker in the world and arouses in himself a sympathetic understanding and appreciation of all those persons upon whom he depends for the worth-while things of life.

GUIDANCE OF INDUSTRIAL ARTS ACTIVITIES

The teacher knows that certain understandings, appreciations, and competencies are essential for the maintenance and improvement of democratic living. The teacher realizes that the opportunities children are given to achieve these qualities democratically in their child world will affect the ways these individuals will react as citizens in their adult world.

In preplanning for leading children through an area of experience in the curriculum, the teacher lists the specific understandings, appreciations, and skills which the children are expected to gain through participation in a given unit. The teacher plans experiences which will promote the children's acquisition of these feelings, skills, and knowledges. Part of the desired outcomes will be reached as the children are guided in processing raw or semiprocessed materials and in constructing articles needed for dramatic play or illustrative purposes. Other outcomes will be realized as the teacher guides the children in the planning, research, and evaluation essential to successful processing or construction.

In order to recognize the industrial arts activities inherent in the unit which could contribute to children's growth in understanding, appreciations, and skills, the teacher must be familiar with the subject-matter content of the unit to be explored. To acquire this familiarity, the teacher may have to read widely to gain an overview of the ways industrial arts have affected the culture that the pupils will explore; collect books, periodical articles, pictures, posters, diagrams, and charts illustrative of the ways in which the people of the particular culture meet or have met their needs for food, clothing, shelter, tools and utensils, weapons, communication, and transportation, or of the processes involved in the particular industry being studied. And he may need to study films, filmstrips, and slides that pertain to the study.

Whenever feasible, the teacher makes study trips to places where information may be obtained, interviews persons especially familiar with the topic being studied, collects available realia, and notes sources from which other realia may be secured when it is needed. After the teacher

has learned what industrial arts processes are a part of the culture the class will study, he selects those that will contribute most to the growth of the children in his class. The teacher performs the processes selected, records the steps used and the materials needed in the experiences, and organizes the required materials so they will be readily available for use by the children.

As in all other teaching-learning situations, the purposes of the teacher and children in relation to industrial arts may not always be the same. The teacher may want the children to engage in an activity so that they will grow in a particular understanding, appreciation, or skill, for he knows that the children's interest in processing or constructing will stimulate them to engage in research which, in turn, will help them to acquire the desirable qualities. The teacher knows that certain social-emotional experiences will provide means for developing respect for the ideas, opinions, and contributions of others and he realizes that the child will gain personal satisfaction as his contribution is accepted by his peers.

As children process the raw materials of nature, the teacher helps them to focus attention on the ways and means by which the materials are changed and on what happens to the materials as they are changed. The teacher emphasizes man's ingenuity and patience in adjusting to his local environment and changing materials from that environment to make them most usable to him. The teacher provides opportunities for the children to make and evaluate choices, draws the children's attention to the blending of utilitarian purpose with designs appropriate to the qualities of the raw materials processed, and helps pupils to compare their activities in processing with modern large-scale production methods. Children are constantly encouraged to analyze and compare objects from their own and other cultures in terms of textures, form, and color, thereby learning some of the established principles of art. As children are encouraged to draw on those principles in judging new objects, they become increasingly able to select wisely as consumers of the products of industry.

The teacher must decide which processing will be done from raw materials, which from semiprocessed, and which from substitute materials. When children cannot perform the initial processing, the teacher must then provide other means to insure that they develop understanding of the steps involved. Audio-visual aids, stories, resource persons, and observation contribute to these understandings.

The teacher must decide which processes are of sufficient importance to the study and to the group to warrant total group participation and which processes should be done by only one or a few individuals. His decisions are formulated as he asks and answers the questions that follow:

How much basic understanding important to children's lives is inherent in the process? What is the relation of the processing to the progress of the unit? Which of the children have had similar experience in previous studies? Do the children at this time need to be drawn together by the social experience of working closely together on a single process? Does the activity involve a problem which is big enough to justify taking the time of the total group to organize and carry it through to solution?

It is the teacher's responsibility to guide children's involvement in industrial arts and to guide the children into construction activities that may become sources of rich emotional, social, and intellectual learning. It is his task to insure that the children have and recognize genuine need to construct specific articles. After the need is established, the teacher must help the children plan how to solve the problems that must be solved in order that the need may be met. The depth, length, and spacing of such planning is determined by the children's ages and their backgrounds of experience.

The children are helped to gain, organize, and present needed information to other members of their group. They are helped to use the information in designing, constructing, and evaluating the needed items. They are helped to use tools and materials successfully. The teacher constantly checks to see that correct concepts are being acquired and that acceptable study, social, and work habits are being established.

Skill in Use of Tools and Materials

As children work with lumber, they become acquainted with the characteristics of wood and the possibilities and problems of working with it. By observing demonstrations of the proper use of tools and materials, and with careful guidance in many construction activities, the girls and boys acquire skill in the safe and efficient use of tools. They develop muscular strength, manual dexterity, and eye-hand coordination. They cultivate sense of form and power of observation as with teacher guidance they establish and maintain work standards appropriate to their levels of development.

Instruction in the proper and safe use of tools begins with the introduction of hammers and nails and continues systematically throughout the elementary school years as other tools are introduced. Demonstrations by the teacher and children accompanied by discussion, experimentation, and practice with tools and materials promote children's skill in using the tools introduced. The proper use of tools and materials in constructing articles suited to the children's developmental levels promotes success which encourages the girls and boys to complete their work.

Guidance by the Teacher

Needs for the construction of articles most frequently evolve from dramatic play; sometimes they come when children need to make an object to use for illustration. Needs for processing materials usually arise from dramatic play, rhythms, construction, or research. Through discussion the children decide what they need to make or do.

The teacher records on the chalkboard the children's ideas and plans for the construction of articles. Important items are transferred to charts which are kept available for reference. The children select jobs from among those which the group has designated as important. They or their teacher write their names beside the jobs selected. Additional needs are added to the chart as the study progresses.

After the class has decided upon the articles to make or processes to do and the order in which the experiences are to occur, the teacher provides time and materials for research and discussion. Sometimes the total group engages in research; sometimes individual or small groups who have accepted specific responsibilities do it. The children are guided to find out how the finished product should look and of what materials it should be made. The amount and type of research in which children engage are determined by the maturity of the children and the availability of informative resources. The individuals or groups of children who have assumed responsibility for the construction or processing do additional research as needed to make the article and its use in dramatic play seem more real, its illustrative use more valuable, or its processing authentic.

Industrial Arts in the Schedule of Activities

The frequency of industrial arts periods depends upon the immediate situation. In primary grades and usually in intermediate grades the children engage in such activities several times each week. As

they are guided to recognize needs for gathering additional information, the girls and boys see the necessity for engaging in further research before continuing with the activity. In the upper and sometimes in the intermediate grades the maturity of the children makes extensive research possible. Also in the upper grades activity periods may be less frequent than in the lower grades.

In the kindergarten and for a part of the first grade not all of the children need to participate in construction or processing at the same time. For those children who do not take part, the teacher plans activities in other centers of interest to meet their needs. As the girls and boys are helped to recognize the need for objects to be made and assume responsibility for making them, more and more children are encouraged to participate until all or nearly all the children in the group are constructing or processing at the same time. Even at this time not every child may be working with tools. All, however, are contributing to group needs by creating something to be used in dramatic play or otherwise used by the group in social studies activities. Some may be designing wallpaper for the house, painting blocks of wood for cargo, painting a background for the play community.

As children mature and begin to assume more of the responsibilities for making things to meet group needs, teachers guide all children so that they will engage in industrial arts activities at the same time.

The Teacher Plans in Advance

Each work period requires careful teacher planning. In doing this planning the teacher takes into consideration the answers he formulates for the following questions:

What new needs for construction or processing are evident?
Has each child selected a purposeful job?
Is every child progressing satisfactorily?
Are the activities and end results valuable to individuals as well as to the group?
Have materials and tools been made readily available?
Are books, periodicals, filmstrips, and other audio-visual materials available to children so they may clarify concepts?
Have appropriate group standards been established so children may work independently or in groups with success?
Have opportunities to participate in other worth-while activities been provided for the children who are not processing or constructing?

Industrial Arts Work Periods

Work periods are busy times for teacher and children. Periods are usually organized to allow adequate time for the children to clarify individual and group needs, to plan so that all persons and groups may know what they are to do and how to do the accepted tasks, to do all or part of the work planned, to clean up the room after work, to discuss progress and to clarify new problems. The amount of time and the number of children involved in planning and evaluating are determined by the maturity of the children and the complexity of the problems.

Planning is part of every work period. Early in the primary grades, and for some children even later, much planning is done "on the spot" with individuals or small groups of children. Later, as the girls and boys are able to think together in larger groups, the teacher guides them to clarify their needs and decide on procedures for the period before they begin to construct or process.

The teacher provides models, diagrams, and other informational materials which will help the girls and boys to visualize next steps in the activity. The children decide what each of them is to do, and suggestions are made as to how each should proceed. The use of space, materials, tools, and time are discussed. The length of time to be used for work is decided upon. Group-established standards for work and clean-up methods are reviewed as the occasion demands. After each child knows what he is to do, all the children start working.

Once the children have started working the teacher moves among them, checking measurements, asking leading questions, and examining their work in order to help the children to evaluate and plan improvement in their construction or processing.

If careful planning has been done, it seldom becomes necessary for the teacher to interrupt the work of individuals or those of an entire group during time allotted for active work. Most problems of total group concern which arise during the worktime may be considered later when the children convene for evaluation. If, however, during observation of the children at work, the teacher notices that the clarification of ideas, procedures, or tool usage is necessary to the successful completion of the work, the entire activity may be stopped long enough to fulfill the observed needs through demonstrations or further discussion and planning. When this has been accomplished satisfactorily, the children return to work.

The work activity should occupy most of the period. Children should not spend this part of the period discussing and sharing ideas, but should work actively. A child cannot saw a straight line nor sand wood effectively if he is talking. Concentration on the task at hand minimizes accidents to the child or damage to the object being constructed.

The teacher keeps notes of children's needs for materials and tools, of problems to be solved or brought up for discussion, of needs for organizational changes, of ideas which should be developed or concepts which should be clarified. The teacher's observation includes the following:

Which children are solving their problems by themselves
Which children are getting needed help from other children and how they are being helped
Which children are working or are not working well with others
Whether or not safety measures are being observed
Which children are or are not working on the jobs for which they have assumed responsibility
How well the children are respecting the rights of others to tools, materials, and space
Whether or not the children seem to be interested and happy as they work

Teachers use different methods of concluding the work period. Some give a warning signal a few minutes before the end of the period so that children will have time to bring their work to a satisfactory close. Some go from group to group and tell the children it is time to put materials away and to clean up their work areas. Some signal with a bell or other soft-toned instrument; others flick the room lights on and off. Some teachers delegate these tasks to children they select.

Clean-up time presents opportunity for children to build attitudes of responsibility regarding the organization, care, and conservation of tools and materials. It is, nevertheless, given the minimum amount of time for accomplishment. Through careful, thoughtful, and thorough organization, tools, materials, and objects under construction can be placed in the proper storage areas without mishap and confusion.

To insure a successful clean-up activity the teacher, prior to the beginning of the work activity, considers all the tasks necessary to its accomplishment: he assigns special tasks to individuals or groups; provides special materials, such as buckets, pans, solvents, and rags needed

for particular tasks; helps children to decide upon the traffic direction to be followed in returning or putting away their work, tools, materials of construction, and cleaning materials; and helps the children establish what they will do if they finish their tasks before the rest of the group finishes theirs.

Some teachers have the children put away the tools and materials with which they have been working before they congregate to discuss their work; others prefer to leave all clean-up activities until the work has been evaluated. Some have the clean-up at the close of the work period and hold evaluation during the pre-work period or the follow-up lesson. It is well to have all children clean their own work areas before they attempt to help their neighbors. Responsibility for a few specific jobs, such as putting away sawhorses, sweeping, and dusting may be assumed by a few children.

Evaluation During Work and After Work Periods

Evaluation is an important part of the program carried on during the work period; it is in continuous operation from the beginning of the work period until the next activity is started.

Evaluation begins with the child at his work when he measures, cuts, and assembles his materials. It is emphasized more as the teacher contacts the child while helping him to overcome specific difficulties. It even occurs with the child in the selection of the tool or utensil to use for a specific task.

In the early part of the primary years much evaluation is done "on the spot" with individuals or small groups of children. As the children mature and are able to think together in large groups, they are called together to discuss what they have done and to clarify concepts.

Children are encouraged to share their work or present it for group evaluation in the following instances:

When they need help from the group
When the teacher feels they need encouragement or praise
When there is evidence of good thinking in working out problems
When the children believe they have completed a job

During evaluation time, the teacher directs the group's attention to some part of the work which has been well done or to find what the next step of construction is to be. In the discussion of the work the children come to observe that which has been done well and to

find out how this was achieved so successfully. This results in the child's peers re-examining their own work to see if there is some way in which it might be made better or to see why they, too, have succeeded in doing something really well.

The notes which the teacher took as the children worked help him to guide the evaluation to a discussion of major problems. Although all children are given opportunity to bring individual problems to the group, they are guided to see their problems in relation to those of other members. They are helped to recognize that some problems need to be considered by the whole class; others can be solved by individuals or small groups. They are helped to find ways of getting help when they need it.

The teacher assumes responsibility for helping children to clarify their ideas by injecting questions or statements as evaluation is being made. He supplies some information to help the children solve their problems, guides them to sources of pertinent information, and helps them through discussion and demonstration to learn to use tools, equipment, and materials properly. The teacher encourages the children to state their suggestions concretely and positively as they discuss their social behavior and the authenticity and quality of the work accomplished. He helps them to evaluate their work in terms of previous group planning and to modify their plans in terms of newly gained information.

The teacher knows that friendly relationships established between him and the children early in the school year do much to create and continue good attitudes. Children need to feel that their teacher is their friend and will support them. When such rapport is established, the girls and boys have confidence in their leader and are able to accept comfortably the constructive criticism which their classmates offer. With such attitudes, children derive from the evaluation period a sense of satisfaction and an eagerness to work again.

Teacher Guidance of Children in Primary Grades

The following description of children in the primary grades engaging in dramatic play and doing the research and construction necessary to move the play forward illustrates many of the principles and practices previously described.

John was expressing through play the adult life of his home community environment in the first grade classroom. Some of his peers

were making use of their own constructed homes, stores, and transportation items to carry on in their play the work of the home and city. Trucks and passenger vehicles of wood construction were busy transporting goods and passengers to the harbor for voyages on the child-made ships, to the airfield for flights on the wooden aircraft produced by the children, and to the downtown shopping centers consisting of stores built by the children.

John was bringing flight 21 in for the landing. He responded verbally, recording the wind direction, altitude, air speed, and runway procedures and directions for landing as they were given to him by the child-operator in the control tower.

After John successfully landed his airplane, he was met by trucks, carts, and dollies which his peers had driven up to unload the baggage and mail and to transport the passengers. John said to a friend at the airport "I'd better 'fill-er-up' for my next flight at three o'clock."

Jean's airplane had also just landed and she repeated John's comments about the need for refueling. Both children tipped closed fists in a pouring action directed at the fuselage of their airplanes.

The teacher observed the children's activity. During the discussion of their dramatic play experiences, the teacher directed the attention of the class to the real quality of John's airplane flight. John described his landing, unloading, and preparation for take-off.

The teacher asked John if he knew how refueling is accomplished with real airplanes. John was not certain, but he thought they "have fuel pumps at part of the airfield so the planes can just taxi over to them." Another child said that, "just small airplanes taxi over to gasoline pumps but the large planes are given gas by big gasoline trucks which drive over to them."

The class members were divided in opinion about the suggestions for refueling. They all agreed that they needed to know about the correct procedure for refueling airplanes.

The continuing discussions brought forth other needs of the group: the market ran out of money; taxi drivers charged too much for "such a short ride"; ocean liners just took passengers for a ride. These needs were noted in writing by the teacher for the planning of future lessons which would alleviate the difficulties of the community living experiences of the group.

The next lesson hour found the children reading a chart prepared by the teacher about refueling the airplane. The story described how

refueling is accomplished, the number of persons involved, the gasoline capacity of tankers and various types of airplanes, the number of gallons of gasoline which could be stored in underground tanks at the fields. She explained the costs, the methods of measurement, payment, and recording of the amount of fuel delivered.

Pictures of refueling an airplane at the airport were examined and plans were considered for taking a trip to the airport to make the children's operation of their own airport more realistic.

The very next activity period brought forth the need for a gasoline truck to refuel the airplanes at the airfield. John, having previously finished making the airplane he flew during the described dramatic play period, now decided to construct a gasoline truck. With the aid of the teacher and his peers, John examined pictures of gasoline trucks. He compared them in size with the vehicles already constructed and in operation in the classroom and with the airplanes already made in order to determine the proper size relationship. He next selected the wood sizes which would help him obtain the desired vehicle relationship "longer than a stake or milk truck, or about the same size as two of these," the trailer being longer than the truck-tractor.

The pre-work discussion also provided Bob an opportunity to obtain from his peers suggestions for fastening the loading boom on his freighter.

Diane needed to know how to cut an opening in the top floor of her wooden box house to put in a stairway, an operation which required the use of a brace and bit. As a result of this need, which had been anticipated by the teacher, a sawhorse, C-clamp, wooden box, and brace and bit were already at the discussion circle. The teacher, assisted by a few children, demonstrated how to use the brace and bit. Upon conclusion of the demonstration, the teacher informed the group that she would come to help them if they would raise their hands. The group then went to work.

These experiences, as well as subsequent planning and construction experiences, led John to select the wood for axles with care. He measured one against the other so that they were of even length. He determined proper placement of the axles on the truck and tractor bed; determined the length of the steering wheel column by comparing it with the reach of the pipestem-cleaner figure seated on the truck seat; measured the height of the upright braces of the truck cab by comparing it with the head height of a pipestem-cleaner figure, measuring

one against the other to procure an even height; marked a straight line for sawing; spaced nails evenly for nailing; and placed the wheels on the axles so that all wheels rested evenly on the floor surface.

Since the teacher had set the room up for construction, with saws, hammers, and C-clamps placed on the floor beneath the sawhorses, which had been arranged in a safe and orderly manner, and had made the other tools, wood box, nail containers, sandpaper, and other supplies easily accessible, John and his peers were able to begin work immediately after planning the work to be done. They needed only to procure their items of work, the wood, nails, or other materials they needed to use and to select a work area.

If work space for all is not available, a wide plank placed across two sawhorses, chairs, or desks to form a workbench will provide a practical solution to the problem of work spaces. Sections of plywood panels placed over the tops of decks may be used to make workbenches.

During each of the work periods, which were long enough to give some satisfaction of accomplishment to the children, yet not so long as to go beyond their interest span, the teacher gave individual help in guiding the children to solve problems and clarify their thinking.

The teacher seldom needed to call the entire class together for an "on-the-spot" demonstration of using a tool correctly, or evaluation of ways of working, or to emphasize a point of safety.

Near the close of each construction period the teacher made note of those children whose work accomplishment would lift the level of the group performance through being shared and enjoyed. Steven had sanded the wings of his airplane very smoothly; Bob had solved the problem of fastening booms onto his freighter; Debby had made the cut-out windows of her wooden box house more attractive by adding window frames of screen-molding; Diane had used the brace and bit to cut an opening for her stairway; Tom for the first time had made something from wood; and John had sawed the piece of wood so carefully and straight that each fitted evenly into place for his truck.

At the conclusion of each sharing time there was a five-to-seven-minute clean-up period. Each child shared in the work of returning tools, sawhorses, and materials to their proper places, in sweeping the floor, and in putting the room in order for the next learning experience.

The scheduled trip to the local airfield helped the class further to clarify airport operational procedures in which they themselves had been involved. It gave each child opportunity to clarify thinking about

his or her own items of construction; about placement of propellers, landing gear, ticket office equipment and arrangement, control tower panel boards; and it gave John help with the placement and functioning of hoses, pumps, measuring devices, and directional signals, and the safety precautions involved with gasoline trucks actually involved in refueling airplanes. The trip indicated such further construction needs as trucks and dollies to handle mail and baggage; a wind cone and wind tee, and beacons and other facilities for their own airport.

Illustration of Teacher Guidance in an Intermediate Grade Activity

A group of fifth grade children studying American Colonial Life were interested in reliving the experience of the people. They had built a fireplace and were eager to play the activities involved in candle dipping. They suggested that making candles would help them "really feel like colonists."

The group read informative material, examined study prints, and looked at a film about candle making. In preparation for their work period, they listed on the chalkboard the materials they would need and the steps they should take to dip candles. Their list and steps in the process follow:

MATERIALS WE WILL NEED

5 lbs. of tallow (rendered)
candle wicking cut to length
candle rods
newspapers
tall container
hot plate
knives for cutting tallow

Following their reading, they developed this chart to show the steps in the process:

HOW WE WILL MAKE OUR DIPPED CANDLES

Cover space on floor by our fireplace with newspaper
Cut wicking in desired lengths and tie it to rods
Cut tallow into small pieces
Fill can half-full of boiling water
Add half of tallow
Place can on a hot plate to melt tallow

Remove can from hot plate
Lower wicks quickly in and out of tallow
Strip candles between fingers to straighten wicks
Allow time for candles to cool
Continue dipping until candles are of desired size
Hang candle rods over chair backs and allow time for candles to harden
Clip candles from rods

The teacher who was helping the children plan to make candles checked over the supplies with them and reminded them of the responsibilities they had accepted. The teacher was to supply the hot plate, the extension cord, and the candle wicking. Frank had promised to bring a tall metal container such as a lard can. An adequate supply of newspapers was available in the cupboard. The bamboo rods were ready for cutting. The teacher agreed to stop at the butcher shop and pick up the tallow which Jim had asked the butcher to save.

The following conversation took place when the group of girls and boys met to plan the candle-making period:

TEACHER: Before we begin our work period are there suggestions you would like to make in order that we may dip our candles safely and successfully?

JOANNE: Our story said that the colonists took turns so they wouldn't spill hot tallow on themselves. We need to be careful too.

LINDA: Maybe we can take turns.

TEACHER: What advantages would there be in taking turns?

JEANETTE: If we took turns, there wouldn't be a crowd around the hot can of tallow.

BARRY: We could have a partner and have two wicks on each rod. Then we could take turns in dipping.

TEACHER: These suggestions would help all 36 of us dip our candles more quickly and with safety. How many people do you think should be around the tallow at one time?

JOHNNIE: Oh, about half of us.

VERNE: Well, that's too many because half of us would be 18, and there isn't room for that many.

BILL: I'd say let's divide into four groups, then only nine would be there at a time.
(The groups accepted this idea.)

TEACHER: Bill's and Barry's suggestions seem reasonable because it means there will be 18 candles being dipped each time. We could be comfortable if we put some chairs around the area. Do you remember the time limit that was suggested between dippings?

JOE: Ten minutes. That means another group could dip while the first candles were cooling.

BILL: Everyone could have a turn that way.

TEACHER: Are there any suggestions which might help us to prepare our materials quickly and safely? Perhaps we can recall what we shall need if we read over to ourselves the steps we listed on the board.

LARRY: I'll cut the tallow.

MIKE: I'll help you, Larry.

TEACHER: Working in committees would surely be helpful. Let's list the committees we shall need.

The teacher wrote committee names on the board as they were suggested for the following activities:

Cutting tallow	Putting the tallow into the hot water
Cutting rods	Preparing wicks
Putting wicks on rods	Protecting the floor

The candle-makers prepared the room with the help of the teacher who lifted the can of tallow onto the hot plate. During the dipping the teacher removed the can of tallow from the plate and replaced it when the tallow cooled. The girls and boys chattered happily as they took turns dipping their candles.

As the children worked, the teacher in the following ways gave individuals and small groups the help and guidance they needed:

Demonstrated how to dip a wick
Helped children strip their candles after first dipping
Reminded two children of standards which group had set
Re-tied a candlewick onto a bamboo rod
Showed a child how to repair a broken candle
Pointed out how one boy carried his candles carefully so that they would not bump together
Pointed out importance of keeping tallow at right temperature
Constantly commended children who dipped their candles quickly

Constantly reminded Tommy to stand far enough from hot tallow so that he would not be burned

After dipping candles several times, the group met at the end of a work period to evaluate their work. An example of good group feeling is related in the following discussion:

MANUEL: Look at my candle; it's really getting big.
JOE: Yours is bigger than mine. I dipped mine just as much.
DEANNA: I think maybe some of us held ours in the hot tallow too long and some tallow melted away. I noticed Manuel dipped his quickly.
LINDA: I want mine to be larger. May we dip tomorrow too?
TEACHER: Do you think our plans worked successfully?
VERNE: Everyone had a turn. I think it was a good work period.
CHILDREN: So do I.
TEACHER: When a group works together as well as we did, it will be easy to finish our work in another period or two.
JOHNNIE SUE: It won't take us long tomorrow; we'll know just what to do.

When all of the candles were finished to the children's satisfaction, the group admired one another's candles with real pleasure. One girl suggested making a candle for the butcher who had given the tallow. Another wondered if all the candles were white in colonial days. Others expressed a wish to make some candles using candlemolds. Continued interest was shown by the children as they experimented with colored and scented candles which were similar to colonial bayberry candles. Subsequent dramatic play was enriched by the actual experience this group had in participating in a genuine colonial activity.

ILLUSTRATION OF TEACHER GUIDANCE IN AN UPPER GRADE ACTIVITY

The following example illustrates the depth of understanding of social problems which may come as children are stimulated to research by construction activities. As they experimented with magnets and objects made of iron, steel, and other metals, a seventh grade class became greatly interested in learning more about iron and steel. They read books and magazine articles, studied films, and visited a nearby steel plant. At the plant they talked with their guide and listened to his explanation as they toured the mill yard, viewed a coke oven, blast

furnace, open hearth shop, and visited blooming and rolling mills, merchant and skelp mills; and pipe, structural, and plate mills. They watched the trains bring raw materials to the plant and carry away the finished products. They saw the slag piles where mill wastes were dumped. They smelled the acrid smoke, felt the sting of wind and cinders, the rush of heat from the furnaces, the grit and dirt. They marveled at the colors of the fires, the molten steel, the cooling ingots, the long gray lines of steel plates.

Upon their return to school the young people expressed their reactions to their visit in many ways—through art, rhythm, music, and creative writing. As they recalled the heavy engine pulling cars laden with ore into the yards, they decided to find out more about the sources of raw materials and to put into tangible form their interpretation of the sources. As a result, one committee made a model of an open pit mine, another made a mural to show the process by which ore gets from the open pit mine to the steel mill, and still another made a model of a shaft mine. These interests drew the young people into a study of the lives and social problems of miners.

The total group decided to consider ways of showing the steps involved in the manufacture of steel. They listed as possibilities diagrams, a flow chart, a mural, and models. They decided to make a model of the mill visited.

The teacher guided the group to recall the parts of the mill, to study a film about the plant, and to re-examine brochures from the plant. After considerable discussion, the students decided to make models of the coke oven, the blast furnace, the open hearth furnace, the soaking pit, blooming mill, and plate mill. They agreed upon a common scale to which all committees would conform. Committee membership was determined and the groups began work.

The teacher gave assistance as needed to each group. Each committee summarized the information gained during the study trip in relation to the part of the plant the committee was to make. Each committee read about the part for which it was responsible. Considerable sharing of materials occurred as members of one committee discovered references applicable to the works of another group. All collected and shared photographs, charts, and diagrams.

The coke oven committee collected and made an exhibit of some by-products of the oven. The blast furnace committee made diagrams on slides to show how the furnace worked, and used the slides to

illustrate oral reports to other members of the class. They also made diagrams for other class members to put in their notebooks. They acquired some pieces of pig iron and compared the iron with wrought iron. They visited a metal shop to watch a worker bend the wrought iron. They tried to bend wrought iron and to work pig iron.

The open hearth furnace committee members became so interested in their topic that they not only constructed their model but read extensively about Kelly's and Bessemer's contributions to the steel industry. They made charts to show the type of work produced by various types of furnaces, charts to compare the amounts of steel made by each type of furnace, and pictorial charts to show how the products made possible by the furnaces have helped the people of the world.

After the committees had selected materials and made the models for which they had assumed responsibility, the class discussed ways of making all models understandable to other pupils in the class. It was decided that the chairmen of the various committees should tell of the work done by men in the parts of the plant for which models had been made.

The pupils soon found they needed to know more about the workers. They interviewed workers and read about them. They learned of labor unions and of some of the problems of management and labor. Studies of the contributions of unions led to a study of safety and first aid measures, of hours of work, and of compensation. Interest grew in comparing the working conditions of 1850 with those of today. Committee members made written reports, charts, and pictures for the reporters to use. This in turn led to a study of the contribution of steel to the development of American industry.

So it went. Construction led to research, which led to more research and more construction and processing. The pupils grew in knowledge and appreciation of the work involved in changing nature's raw materials into products usable by the people of the world and in knowledge and appreciation of the many problems of the people who are and have been involved in the processing.

IMPLEMENTATION OF INDUSTRIAL ARTS ACTIVITIES

Teachers, school administrators, supervisors, and consultants realize that industrial arts should be an integral part of the elementary school curriculum, but they also recognize that the activities need to be implemented in order to take their proper place in the school program.

Implementation begins with the preservice preparation of teachers and should extend into the in-service training program. An increasing number of teacher-education institutions are becoming aware of the need to provide classes in industrial arts for elementary school teachers. Many school systems, too, are implementing the industrial arts activities through workshops, after school meetings, and classroom observations.

It has been said that he who would kindle others must himself glow. This may be applied to the school administrator. It is he who can inspire teachers and can make available to them the help, the materials, and the resources needed to carry on industrial arts activities.

Interpreting the value of industrial arts to parents is another important part of implementation, for as parents observe the enthusiasm of the children who are engaged in producing something useful from raw materials, such as clay or wood, they become interested and are eager to learn more about the program and its relation to the school curriculum.

Since industrial arts experiences can and will vitalize learning for boys and girls, the industrial arts program is worthy of the finest implementation that teachers, school administrators, supervisors, and consultants are able to give.

Preservice Preparation of Elementary School Teachers

Public education is currently faced with a problem in growth that is far greater than anything ever anticipated. This growth is of such magnitude that many leaders in the field of education are baffled as to its solution. The problem, which is two-fold in nature, involves: (1) obtaining school housing sufficient for inflated school enrollments, and (2) obtaining a sufficient number of well-trained teachers.

The school population today is at an all-time high, but predictions are that within the next few years it will be even greater. Such an increase in enrollment will also increase the need for teachers and school buildings. If the problems caused by these conditions are to be solved, school building programs must be expedited, teachers must be recruited, and teacher education institutions must be geared to prepare teachers for an educational program essential to the needs of contemporary life.

Teachers for the public elementary schools of California come from two sources—California colleges and universities and out-of-state colleges and universities. A high per cent of the teachers now employed attended out-of-state institutions of higher learning. As a result, differences exist in the teachers' philosophy of teaching elementary industrial arts as integrated curriculum activities and in the teachers' preparation to teach them as such.

Elementary teachers are being trained for the California public schools by the University of California, the state colleges, and the private collegiate institutions in the state. The primary objectives of the California teacher education programs is to prepare teachers for employment in California public schools and to provide them with the proper backgrounds to meet current educational needs.

A survey of California teacher education institutions indicates that only a few provided training for elementary teachers in the field of industrial arts. However, the faculties of the institutions were of the opinion that such preparation would be valuable to all prospective teachers. Only five of the institutions that maintain industrial arts programs provide work in elementary school industrial arts. None of the institutions requires candidates for elementary school teaching credentials to complete any of the industrial arts courses offered in its program.

The courses in elementary school industrial arts provided by the industrial arts departments were all similar in content but in most instances the course titles differed. In all cases the courses were coordinated with the required methods courses for elementary school majors. It was generally agreed that the elementary industrial arts program should emerge from some phase of the elementary curriculum and should be taught by the classroom teachers and that the activities are frequently neglected because the teacher does not have adequate preparation in industrial arts and therefore feels insecure in undertaking the required activities.

Every elementary teacher should have opportunity while completing his professional preparation to secure training in elementary school industrial arts. Such training should be provided on an activity basis in the industrial arts department in the teacher-education institution. Courses should be taught by instructors with backgrounds in elementary school industrial arts work and the other training needed to conduct well-rounded programs appropriate to the maturity levels of elementary school children.

It is essential that the instructor have a thorough understanding of the elementary school curriculum to which industrial arts activities are related. If the teacher education institution does not have staff members who are adequately trained in this phase of elementary education, the institution should secure the services of qualified instructors from the public elementary schools. Instructors with backgrounds of in-service education in elementary school industrial arts could be used to good advantage.

The elementary school industrial arts work should provide experiences in many areas such as the making of rhythm instruments, woodworking, stenciling, linoleum block work, silk screen printing, copper foil work, general leather-work, weaving, clay modeling, related industrial arts-science projects, cement molding, and model building. These should be incorporated into the program so that they satisfy the objectives for the educational level at which they are taught.

It is imperative that the elementary school industrial arts program in the teacher education institution be co-ordinated with the programs offered by the schools in the area served by the institution. The curriculum should be organized in co-operation with the public school personnel responsible for the program and should be constantly evaluated to determine whether the participants are being adequately prepared to carry on the work in the public schools. Through these procedures the teacher education institution can most fully further a worth-while program in the elementary school.

The teacher education program in industrial arts should provide opportunities for participants to acquire the background of information and to develop skills every elementary teacher should possess. These should include the following:

1. To develop skill in the use of common hand tools and an ability to demonstrate their use to others

2. To acquire a knowledge of industrial arts objectives applicable at the various educational levels
3. To acquire a knowledge and develop the ability to organize and carry forward an activity program
4. To realize the value of construction and its relationship to the curriculum
5. To acquire a knowledge of the proper tools, supplies, and equipment used in industrial arts activities
6. To develop knowledge of the time normally required for various activities
7. To develop knowledge of appropriate projects related to the various curriculum units
8. To acquire a knowledge of the sources for materials and methods for their procurement
9. To develop a safety-consciousness in the use of tools and materials
10. To develop a portfolio of resource materials for elementary school industrial arts work

The teacher candidate should in all cases be assigned to a student teaching situation where the opportunity will be provided for work in industrial arts. This experience will provide an opportunity to see at first hand how the activity program is guided in the public schools.

Elementary industrial arts should be given increased emphasis in the curriculum of teacher education institutions. Several colleges and universities who do not currently provide such courses within their industrial arts department stated that they would like to offer such training in the near future. It is imperative that this expansion take place so that all California trained teachers have this preparation. Teachers from out-of-state who have not had such training can take the required work in colleges and universities and in-service work can be provided for those now in the teaching field.

In-service Education of Teachers

"Teachers teach as they are taught and not as they are taught to teach." This statement has often been repeated by administrators as they observe teachers teaching their first classes.

The preservice industrial arts background of teachers is often inadequate. Thus school administrators, supervisors, and consultants

should provide opportunities for the in-service education of the new teachers as well as for those experienced teachers who desire help in a specific area such as industrial arts. This in-service education may be provided in a variety of ways including workshops, preschool induction meetings, institutes, accredited workshops of colleges and universities, summer schools, classroom observation, services of helping teachers and school industrial arts chairmen, and study trips.

Workshops. One of the most interesting developments of recent years has been the workshop. In academic parlance, the name may seem slightly misleading but for the industrial arts program, the workshop is truly a workshop, a place where teachers may gather in small or large groups to work on educational problems, processes, and projects.

When schools are too distant from a workshop center, a co-operative type of workshop may be scheduled at one school during out-of-school hours. A workshop such as this may be arranged and a general bulletin of announcement sent to the respective schools in a specific geographic location. The host school should be easily accessible and should be located away from congested areas to facilitate parking.

The host administrator in co-operation with the supervisor should make arrangements to have available a working area with adequate space and equipment, such as tools and sawhorses and necessary instructional materials.

One can readily appreciate the advantages of a workshop situation and the satisfaction that a teacher experiences as she brings her first project, which might be the construction of a boat or truck to be used in a primary grade, to a successful conclusion. Meanwhile other teachers may work on different projects, such as a covered wagon, a Chinese bowl, a belt loom, an electromagnet, a crystal set, or other objects.

Preschool Induction Meetings. In order to help teachers understand better the role of industrial arts in the classroom, a series of preschool meetings for new or experienced teachers or both may be developed. Leadership in these meetings may come from principals, master teachers, and supervisors.

Institutes. Institutes are one of the oldest forms of in-service education for teachers. Industrial arts should receive emphasis in a well-planned institute. A continual attempt should be made in these meetings to show how industrial arts experiences are integrated in the curriculum. One type of offering could be a series of demonstrations by master teachers on various industrial arts activities.

Accredited Workshops. In addition to locally conducted industrial arts workshops, institutes, induction and in-service meetings, many teachers attend university and college extension classes. In well-equipped workshops they can become familiar with industrial arts activities while earning college credit. These classes are often conducted by both resident instructors and specialists drawn from the surrounding school districts.

Summer Schools. Teachers may be encouraged to attend local or nationally recognized institutions of college level during the summer where special industrial arts courses are offered. Frequently these courses are taught by school supervisors who are well acquainted with local instructional needs.

Classroom Observation. Classroom observations are probably one of the best ways to provide for the in-service education of teachers. Observing an actual classroom situation in which children are participating in industrial arts activities is an experience not likely to be forgotten. The benefits derived by the visiting teacher far outweigh the inconveniences which the visit may entail.

Helping Teachers. Master teachers who have an especially fine background and an interest in industrial arts may be released from the classroom to serve as helping industrial arts teachers. They may plan workshops, be scheduled for classroom help, special conferences, or meetings with an entire school faculty.

School Industrial Arts Chairmen. In order further to implement the industrial arts program in the individual school, one teacher in a building may be appointed as a key person to aid in developing a strong and purposeful industrial arts program. This teacher should, with the help of his principal, become increasingly informed relative to equipment, supplies, lumber orders, tool carts, scheduling, and the purposes and values of the program.

Study Trips. Local industries are often willing to have teachers bring children to visit their plants. Much firsthand information can be obtained through this experience.

Resource People. Resource persons from the community or recognized leaders may sometimes be used for workshops, institutes, and in-service programs. These individuals add new life and vitality to the program and may serve as demonstrators, workshop leaders, or consultants. Many parents and members of parent-teacher associations have specialized talents in industrial arts. Teachers and children profit

greatly from afternoon or evening workshop demonstrations conducted by such people.

Role of the Administrator

The principal in his role as administrator of the elementary school is the key person to whom teachers look for help and guidance. The principal who believes in and understands the value and importance of industrial arts activities and of children having firsthand experiences with the ways that man has used to convert raw materials into more useful products encourages teachers to make such experiences a vital and integral part of the curriculum.

In some sections of the state, school principals, who have felt the need of improving their background and understanding of a particular part of the school program, have, together with the supervisory staff, organized workshops for themselves in such areas as arithmetic, social studies, kindergarten program, and geographical concepts. The effective utilization of industrial arts might be a topic for such a workshop or might better be considered a part of a series of workshops related to the integrative curriculum of the elementary school.

The school principal has an opportunity to observe within his own building children participating in firsthand industrial arts experiences. He may see how these experiences vitalize learning as they provide functional opportunities to clarify concepts, strengthen motivation for and use of reading, writing, and arithmetic skills, and help children to develop appreciations, good habits, and attitudes. He may also note that personal satisfaction, self-confidence, and ego status in a group result when a child makes an article which has value for the group.

The principal may see examples of growth that individual children are achieving, such as the following illustrations:

> Capable Judy being the chairman of the day for the sixth grade committee making linen paper. Judy had made paper the previous day and was showing the new committee the process, step by step. Mary Ann, so lacking in self-confidence, receiving the admiration of the entire fourth grade class for the beautiful design she has made on her tolavera plate.
>
> Tommy, in third grade, making a rabbit stick with an eagerness and a persistence that has been totally lacking until now. Tommy confides that as head of a Pueblo Indian family he needs that stick for the rabbit hunt.

Examples such as these point out clearly to the school administrator the purposes and values of industrial arts, and he in turn will want to find ways to help teachers to see, understand, appreciate, and want to incorporate such experiences in the curriculum.

One way to implement the industrial arts program would be to involve part or all of the school teaching staff in a program for improvement of instruction and effective utilization of industrial arts. The number of teachers involved is not always important; it is important that a start be made. For example, one entire school faculty might select industrial arts as an area on which they wish to work or the teachers of the intermediate grades might decide to study intensively the industrial arts processes related to the curriculum units in these grades.

The principal may provide leadership by arranging and conducting meetings in which teachers are encouraged to clarify their thinking through discussion of values, purposes, problems, and needs. He may take over the teaching of classes in order to provide opportunities for interclass or interschool visiting.

The principal will try to provide easy access to essential tools, materials, and equipment.

The principal will try to create an atmosphere in which teachers will feel comfortable about starting to work in the area where they have the greatest interest or need. For example, teachers may experience the following:

Feel the need to learn about tools

Wish to explore the possibilities for firsthand industrial arts experiences inherent in the unit of work which they are teaching

Wish to know more about how to organize the class

Wish to know how to do certain industrial arts activities, such as how to make papyrus, parchment, a covered wagon, or a Mexican house

Be interested in noting the ways in which gifted, normal, and disturbed children respond to constructing or producing an article.

The principal may contact resource people if their assistance is needed. He will be sympathetic to problems and interested in even a little progress. He will plan faculty meetings with the teachers where they may hear one another's progress reports, discuss observation lessons which some teachers may have attended, and evaluate procedures.

Administrators have found that appointing one or more teachers in a school to serve as the industrial arts chairman in charge of scheduling and checking tool carts, and giving help with use of tools, has proved successful.

The principal's enthusiasm, interest, and firm conviction about the value of industrial arts experiences may be the deciding factor in carrying forward a successful program. He may wish to check on his work by asking himself questions such as those that follow:

Have I done everything possible to support and maintain the program?
Have I discussed with the faculty the purpose and value of industrial arts experiences?
Have I helped each teacher to become familiar with the industrial arts processes related to a specific unit of work?
Have I made provision in the budget for tools and materials needed to carry on specific industrial arts activities?
Have I encouraged each teacher to guide children in acquiring not only facts, concepts, and skills related to the object being made, but interests and abilities which lead to feelings of satisfaction and personal worth?
Have I planned to release teachers for observation lessons in industrial arts?
Have I planned opportunities for teachers interested in similar activities to meet together to share methods and to learn procedures?
Have I taken an interest in what teachers and children do in industrial arts?
Have I offered my assistance or obtained the assistance of a person able to give teachers needed help?
Have I visited classrooms and conferred with teachers regarding organization and use of materials, techniques, and the responses of children?
Have I arranged opportunities for teachers to share experiences and to evaluate outcomes?

Developing and Maintaining Public Interest in the Program

There should be full provision for interpreting the industrial arts program to the patrons of the elementary school. Parent-teacher association meetings may be used for this purpose. The values of industrial

arts may be discussed by a speaker or panel. Children may show articles which they have made and discuss what they have learned during the making. Grade level meetings, too, offer opportunities for the principal and the teachers to interpret to parents the purpose and value of first-hand industrial arts experiences. Many districts invite parents to participate in planning curriculum projects which may involve these experiences.

Parents may be invited to visit a dramatic play period at school. There they may observe children using the items that they have constructed. A discussion period led by the teacher, principal or supervisor might follow to emphasize the importance of direct experience in the learning process.

An excellent opportunity is provided during Public Schools Week for parents to observe and participate in industrial arts activities. One evening during that week is often designated as Open House Night. At this time a few children in the various classrooms may engage in activities, such as constructing a glider, weaving on a box or upright loom, making a telegraph key, making pottery by the coil method, and making adobe bricks. Parents may watch and then engage in the actual experiences with children if they desire.

A variation of this is the Industrial Arts Fair which may be held in the cafeteria, library, auditorium, on the stage, or in an unused classroom. Here, too, children may engage in industrial arts experiences, which though usually integrated with their regular classroom work may be shown in this way for one evening. An explanation of the background, purposes, and understandings that have grown out of the activity should accompany the demonstrations. As in the classroom, parents may watch and be encouraged to participate if they desire.

A hobby show where children are invited to bring objects they have made or constructed at home, and to which parents are invited, will often reveal the far-reaching effect of an interest which started with an experience in industrial arts at school.

Sometimes objects made in school to be used in connection with social studies, language arts, or science, may be taken home during the process of construction, and progress may thus be shared with parents. At this time and later when their purpose in the classroom is fulfilled and they are taken home, the objects may show parents the quality of experience in industrial arts.

Seventh and eighth grade children frequently make objects which they give to their parents especially at a holiday like Christmas or Mother's Day. The situation may be different in kindergarten through grade six. Gifts at these levels should not involve a disproportionate amount of school time, material, money, or direction by the teacher, and may be a simple picture, card, or booklet made or designed by the child.

What happens to a child during the making of something is of far greater importance than the product itself. Each child should be encouraged and helped to develop his own unique qualities and talents in order that he may make his individual contribution to life. This concept is one that should be discussed with parents if they are to appreciate and understand the role of industrial arts in the elementary school of today. In the final analysis, public interest is probably most keenly aroused and the industrial arts program most highly publicized and ardently interpreted to parents by those enthusiasts who are most vitally concerned—the children.

LISTS OF SUGGESTED BASIC HAND TOOLS AND SUPPLIES

The selection of the kinds and quantities of tools and supplies is an important step in planning industrial arts activities at the elementary school level. Lists prepared by the offices of the Tulare and San Bernardino county superintendents of schools appear in this section.

The following lists of suggested basic hand tools and supplies for industrial arts activities were prepared by the Division of Instructional Services, Office of the Tulare County Superintendent of Schools.

List of Tools for the Primary Grade

Quantity	*Description*
3	Saw, crosscut, 16", 11 pt., Disston D23H
12	Saws, coping, wire frame, Parker #210
12	Clamps, carriage, 4", Jorgensen #104
8	Hammer, claw, 7 oz., Plumb #83
8	File, shoe rasp, 10", Nicholson, 4-in-hand
2	Dispensers, glue, Wilhold, "Glue-Bird"
1	Drill, hand, Stanley #610
1	Drill, twist, carbon, Cleveland, ⅛"
1	Drill, twist, carbon, Cleveland, 3/16"
1	Drill, twist, carbon, Cleveland, ¼"
2	Screwdrivers, 4", plastic handle, Fuller #501
1	Pliers, side cutting, 6", Crescent #50

List of Tools for the Intermediate Grade

The list of tools for the intermediate grades should include the tools listed for the primary grades and the following additional tools:

Quantity	*Description*
3	Squares, try, 8" blade, Stanley #12
2	Planes, block, Stanley #118 "School Plane"
2	Chisels, paring, ½" blade, Stanley #61
1	Brace, ratchet bit, 10", Stanley #945
1	Bit, auger, Irwin #62T 4/16"
1	Bit, auger, Irwin #62T 6/16"

Quantity	*Description*
1	Bit, auger, Irwin #62T 8/16"
1	Bit, auger, Irwin #62T 12/16"
1	Bit, expansive, ⅞" to 2½" holes, Clark #1
1	Snips, aviation, combination, 10" Wiss #M3

List of Tools for Grades Seven and Eight

The list of tools for grades seven and eight should include the tools listed for the primary and intermediate grade levels and the following additional tools:

Quantity	*Description*
1	Square, carpenters, 2-ft., blued, Stanley #3B
1	Saw frame, hack, adjustable, Disston #368
3	Knives, putty, metal handle, Warner #402
3	Rule, push-pull, 6 ft., flexible steel tape, white face
1	Saw, keyhole, 10", taper blade, Disston #15
4	Nail sets, 2/32", Stanley #11-¾
2	Files, metal, 8", Nicholson "Handy File"
2	Vises, wood, Columbia #6-CD, "Woodcraft", 6"
1	Oil can, small, plastic top, about 2" dia.
3	Saws, crosscut, 20", 10 pt., Disston #D8
3	Hammers, claw, 13 oz., Plumb

List of Basic Hardware Supplies
(for Grades One through Eight)

Quantity	*Description*
2 rolls	Stovepipe wire, black
1 Lb.	Washers, #8, flat
1 Gross	Copingsaw blades, 6½", pin ends, Atkins
3 Pkg.	Carpet tacks, ½"
1 Gross	Copingsaw blades, 6½", pin ends, Atkins
3 Pkg.	Carpet tacks, ½"
1 Gross	Flat head wood screws, ¾", #8
1 Gross	Round head wood screws, 1¾", #8
4 Lbs.	Box nails, 2-penny
4 Lbs.	Box nails, 6-penny
4 Lbs.	Finish nails, 4-penny

Quantity	*Description*
4 Lbs.	Finish nails, 6-penny
4 Lbs.	Finish nails, 8-penny
1 Lb.	Wire brads, ¾", #18, finish heads
1 Sleeve	Flint-Paper, medium (100 sheets)
1 Roll	Masking Tape, ¾" x 60 yds.
4 Doz.	Dowel, ¼"
2 Doz.	Dowel, ⅜"
1 Doz.	Dowel, ½"
1 Doz.	Dowel, ¾"
1 Doz.	Dowel 1"

List of Basic Paint Supplies
(for Grades One through Eight)

Quantity	*Description*
1 Qt.	Stain, oil, maple, Sherwin-Williams #334
1 Qt.	Stain, wiping, dark walnut, fast dry Sherwin-Williams #S64N27
1 Gal.	Shellac, white, 4 lb. cut
1 Gal.	Solvent, Shellac, "Shellacol"
1 Gal.	Varnish, spar, gloss, Rex Spar
1 Gal.	Glue, Wilhold
1 Lb.	Wax, paste, Tre-Wax
	Lacquer, Sherwin-Williams, Industrial "Opex"
	—Vermilion (primary shade) LG1R24
	—Blue (primary shade) LG1L23
	—Yellow (primary shade) LG1Y25
	—White (primary shade) LG1B21
	—Black (primary shade) LG1B21
2 Gal.	Thinner, lacquer (in METAL can) Opex #3, R7K11
2 Cans	Plastic Pressure spray, clear
1 Sleeve	Flint paper, medium (100 sheets)
5 Lbs.	Paste, wheat
1 Roll	Tape, masking, unpackaged roll, ¾"
12 Only	Brushes, paint, ½" wide, S-231
6 Only	Brushes, paint, 1" wide, S-231
4 Pkg.	Steel wool, #3/0, ¾ Lb.
1 Lb.	Plastic wood, can

List of Basic Lumber Supplies

(Quantity Based on 100 Pupils, Grades One through Eight)

Quantity	*Description*
16 Pieces	1x12x4′ Pine (Ponderosa), #2, S4S

Rip above to following widths for classroom use:

Quantity	*Size in Rough*	*Finished Size Wanted*
4	1x12x4′	¾x11⅝x4′
16	1x4x4′	¾x4x4′
16	1x2x4′	¾x2x4′
20	1x1x4′	¾x¾x4′
Remainder	1x1x4′	¾x⅜x4′
3 Pieces	2x6x4′ Redwood	

Rip above to following widths for classroom use:

Quantity	*Size in Rough*	*Finished Size Wanted*
4	2x6x4′	1⅝x5⅝x4′
8	2x4x4′	1⅝x3⅝x4′
8	2x2x4′	1⅝x1⅝x4′
8 Bundles	Plywood Mill-ends, Assorted (Planing Mill)	

The following list indicates the number and size of tools recommended by the office of the San Bernardino County Superintendent of Schools for self-contained classrooms of the elementary grades.

A Suggested Minimum List of Supplies for a Class of 30 Children

Items	Size	Kinder-garten	Grades 1-2	Grade 3	Grade 4	Grade 5	Grades 6, 7, 8
Hammers	7 oz.	8	12	6	2		
	13 oz.			6	8	6	6
Handsaws, crosscut	14″	3	2				
	20″		6	6	6	6	4
Handsaws, rip	26″		1 kept by teacher	1 kept by teacher			
Backsaws	12″	3	3	3	1		
	14″				1	1	1

A Suggested Minimum List of Supplies for a Class of 30 Children (Continued)

Items	Size	Kindergarten	Grades 1-2	Grade 3	Grade 4	Grade 5	Grades 6, 7, 8
Coping saws	Non-adjustable	2	5	5	4	3	2
	Adjustable				2	3	2
Coping saw blades	Medium pin	3 doz.	3 doz.	3 doz.	4 doz.	3 doz.	3 doz.
	Fine loop					1 doz.	1 doz.
Keyhole saws			3 kept by teacher	2	2	4	2
Clamps	6"	8	12	12	15	10	6
Braces	Non-ratchet	1	2	2			
	Ratchet				5	2	1
Auger bits wood boring	¼"	1	1	1	1	1	1
	½"	1	1	1	1	1	1
	¾"	1	1	1	1	1	1
	1"	1	1	2	5	1	1
Hand drills			1	1	1	1	1
Bits, twist drill	¼"		1	1	1	1	1
	⅛"				1	1	1
Wood rasps with handles	8" fine		2	3	6	2	3
Wood files with handles	8"		1	1	2	3	3
Shoe rasps	8"	3	4	3	2	4	
File cards		1	1	1	2	2	1
Tri squares	"	3	4	4	4	3	2
Steel squares	9" x 12"					1	1
Wood chisels	¼"					2	
	½"				2	1	
	¾"				2	1	1
	1"				2	2	
Wood gouges	½"					2	
	¾"				5	2	1
	1"				5	2	
Wooden mallets	2½"				15	8	2
Screw Drivers	3"	1	1	1	1	1	1
	4"	1	1	1			1
Pliers	6"	1	1				1
Side cutting pliers	6"		1 kept by teacher	1	1	1	1

Items	Size	Kindergarten	Grades 1-2	Grade 3	Grade 4	Grade 5	Grades 6, 7, 8,
Tin snips	8″	1 kept by teacher	1 kept by teacher	1 kept by teacher	1	1	1
Mitre boxes		6	8	8	6	3	2
Block plane	Small					1	1
	15″	6	1				
	16″		8	3			
Sawhorses	18″	1	1	7	4	2	
	20″				4	6	3
	22″						3
Tool cart	26″ long	1	1	1			
	31″ long				1	1	1

Other Necessary Supplies

Other supplies which teachers find helpful in industrial arts activities are clear airplane dope for use in tightening and strengthening muslin drumheads; ground asbestos for making papier-mâché for relief maps and puppet heads; wooden beads for use as heads for pipe-cleaner figures; balsa woods for making kachina dolls; box shook to use for truck and train bases, boat decks, and building roofs; wooden boxes and crates for making small buildings; wooden buckets for making drums; button molds for lights and wheels; candle wicking; cards for processing raw wool; cheese cloth for use in working with clay; Indian corn; cotton bolls, cotton ginned or unginned, or slivered, carded, and ready to spin to use in clarifying understanding of the process, or to process; lead felt for making toy people; flax in various stages of processing; gourds of different sizes and shapes for making utensils; green cowhides for making parchment, sheep and rabbit pelts; cattle horns for making powder horns; sheet lead; leather thongs; scrap lumber; unbleached muslin; needles and thread; papyrus; wheat paste for making papier-mâché; pipe cleaners for making toy people; casting plaster for making relief maps, models, and molds; plastic cloth to preserve clay work; wood putty for use in construction; ropes for *reatas*, ladders, beds; sand paper; silkworm eggs, silkworm cocoons for processing thread and silk culture exhibits to understand process; tongue depressors for belt looms; wooden wheels of various sizes; and raw wool and wool yarn for processing and weaving.

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